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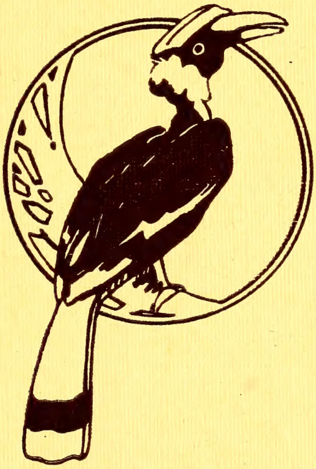

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The Bats of the Andaman and Nicobar Islands

BY

J. E. Hill

Department of Zoology, British Museum (Natural History)

This paper summarises the species of bats so far known from the Andaman and Nicobar Islands and provides notes on a small collection of bats obtained by Mr. Humayun Abdulali during visits to various islands in the two groups. His efforts have added *Megaderma spasma* to the list of bats recorded from the Andamans and *Taphozous saccolaimus crassus* to those known from the Nicobars. Further specimens of *Hipposideros diadema nicobarensis* and *Pipistrellus javanicus camortae* have been obtained, enabling an assessment of the taxonomic status of these hitherto poorly known forms to be made.

The bat fauna of the Andaman and Nicobar Islands is known from a wide diversity of descriptions and records. Consequently, the examination of a collection of bats obtained in these islands by Mr. Humayun Abdulali in the course of two ornithological trips has prompted a brief review to establish a basis for any future studies. Consisting of thirty-six specimens representing ten species, the collection adds *Megaderma spasma* to the bats so far recorded from the Andamans and *Taphozous saccolaimus crassus* to those so far known from the Nicobars. I am indebted to Mr. Abdulali and to the Bombay Natural History Society for the opportunity of studying this interesting collection, of which some specimens have been donated to the British Museum (Natural History), the balance being retained by the Society. Specimens are denoted by the field collection numbers which form two separate series, one referring to specimens from the Andaman Islands, the other to those collected on the Nicobar Islands.

MEGACHIROPTERA

Pteropus (?) hypomelanus satyrus Andersen

Pteropus satyrus Andersen, 1908, *Ann. Mag. nat. Hist.* (8), **2**:362. Narcondam Island, Andaman Islands.

Andersen (1908:363) at first thought that *satyrus* probably replaced the widespread *P. hypomelanus* in the Andaman Islands but subsequently (1912:142) considered it to be the Andamanese representative of *P. hypomelanus*, probably most nearly related to *P. h. geminorum* from the Mergui Archipelago. Ellerman and Morrison-Scott (1951:95) tentatively listed it as a subspecies of *P. hypomelanus*.

Pteropus faunulus Miller

Pteropus faunulus Miller, 1902, *Proc. U. S. natn. Mus.* **24**:785. Car Nicobar Island, Nicobar Islands.

1 sex unknown. Car Nicobar.

This specimen was sent by the Bombay Natural History Society to the British Museum (Natural History) in 1964 so that its identity could be verified. It was then returned and it has not been available for examination during the preparation of these notes. In colour it agrees very closely with the description by Miller and with one of the three examples referred to *faunulus* in the collection of the British Museum (Natural History). It differs from the remaining two [one, B.M. 6.4.13.1 that described by Andersen (1912:143)] in having a paler dorsal surface with the mantle, head, and ventral surface brighter and less tawny. Andersen (1912:143) considered *faunulus* allied to *P. hypomelanus* and it has a close similarity to *P. h. enganus* from Engano Island. Their dissimilarities do not seem very great and it is probable that *faunulus* may prove to be no more than a subspecies of *P. hypomelanus*.

Pteropus melanotus melanotus Blyth

Pteropus edulis Blyth, 1846, *J. Asiat. Soc. Beng.* **15**:367 (not of E. Geoffroy, 1810).

Pteropus nicobaricus Fitzinger, 1861, *Sber. Akad. Wiss. Wien.* **42**:389 (nom. nud.). Nicobar Islands.

Pteropus melanotus Blyth, 1863, Cat. Mamm. Mus. Asiat. Soc. 20. Nicobar Islands.

Pteropus nicobaricus Zelebor, 1869, Reise " Novara ", Säugeth. 11. Car Nicobar Island, Nicobar Islands.

Pteropus melanotus is recorded from the Andaman Islands (as *P. nicobaricus*) by early authors until and including Trouessart (1904). However, Mason (1908:162) separated specimens from the Andamans as *P. tytleri* and this view is elaborated by Andersen (1912:224), who gave further diagnostic characters.

Pteropus (?) melanotus tytleri Mason

Pteropus tytleri Dobson, 1874, Cat. Chiroptera Indian Mus., 3 (nom. nud.). South Andaman Island.

Pteropus tytleri Dobson, 1876, Monogr. Asiat. Chiroptera, 189 (nom. nud.). South Andaman Island.

Pteropus tytleri Mason, 1908, *Rec. Indian Mus.* **2**:162. Rutland Island, South Andaman Islands.

Ellerman and Morrison-Scott (1951:96) pointed out that *tytleri* does not seem a valid species and that Chasen (1940:28) had reduced the other members of the *melanotus* group of Andersen (1912:223) to subspecies of *melanotus* although treated as distinct species by this author. Certainly, *tytleri* is separated from *P. m. melanotus* by no greater extent than are *P. m. modigliani* from Engano Island or *P. m. natalis* from Christmas Island.

Pteropus vampyrus (Linnaeus)

Vespertilio vampyrus Linnaeus, 1758, Syst. Nat. 10th. ed. **1**: 31. Java.

The evidence for the existence on the Andaman and Nicobar Islands of a large fruit bat referable or allied to *P. vampyrus* is reviewed by Miller (1902:786) and Andersen (1912:343). Fitzinger (1861:390) listed a specimen from the Nicobar Islands [as *Pachysoma giganteum* (not of Brünnich, 1782)] which was later described from Car Nicobar by Zelebor (1869:10) (as *Pteropus edulis* var. b. *Pachysoma giganteum*). A further record is provided by Dobson (1878:50) who described (as *Pteropus edulis*) a specimen from the Andaman Islands. Mason (1908:165) stated that *P. vampyrus* (as *P. celaeno*) occurs throughout the Nicobar Islands as a seasonal migrant.

Pteropus giganteus (Brünnich)

Vespertilio gigantea Brünnich, 1782, Dyrenes Historie, **1**:45. Bengal, India.

Mason (1908:165) recorded *P. giganteus* (as *P. medius*) as an occasional and rare straggler to the Andaman Islands, noting that it had then been encountered on but two occasions, on North Andaman Island.

Cynopterus brachyotis scherzeri (Zelebor)

Pachysoma scherzeri Fitzinger, 1861, *Sber. Akad. Wiss. Wien.* **42**:390 (nom. nud.). Nicobar Islands.

Cynopterus marginatus var. (*Pachysoma scherzeri*) Zelebor, 1869, Reise "Novara," Säugeth. 13. Car Nicobar Island, Nicobar Islands.

2 ♀♀ Nos. 15 (juvenile), 16 (young adult). Trinkut Island, Nicobar Islands. 11th March, 1966. Hanging under the midrib of a coconut frond together with a third differently coloured bat which escaped.

The dorsal surface of the head and the anterior part of the back in the young adult specimen (No. 16) is less brown and more greyish than in specimens from Car Nicobar Island and the posterior part of the back is very slightly paler. The juvenile specimen (No. 15) is dark grey in colour, the underside very slightly paler than the back.

Cynopterus brachyotis brachysoma Dobson

Cynopterus brachysoma Dobson, 1871, *Proc. Asiat. Soc. Beng.* 105; *J. Asiat. Soc. Beng.* **40**:260. Andaman Islands.

Cynopterus marginatus var. *andamanensis* Dobson, 1873, *Proc. Asiat. Soc. Beng.* 148 (nom. nud.); *J. Asiat. Soc. Beng.* **42**: 201, pl. 14, fig. 5. Andaman Islands.

2 ♂♂ Nos. 88, 89. Mandapahar, Chiria Tapoo, South Andaman Island. 15th February, 1964. Small cave on seashore. Weight 51 gms. each.

The posterior part of the back in these specimens is very slightly paler than in *C. b. scherzeri* and in one (No. 88) the anterior part of the back is less brown and more olivaceous. The other specimen has the throat and the sides of the neck suffused with rufous.

In life, the skin covering the larger bones of the wing was conspicuously pale.

MICROCHIROPTERA

Taphozous melanopogon melanopogon Temminck

Taphozous melanopogon Temminck, 1841, Mon. Mamm. **2**: 287. Bantam, Western Java.

3 ♂♂ Nos. 85-87. Mandapahar, Chiria Tapoo, South Andaman Island. 15th February, 1964. Out of a party of 10-15 in small cave on seashore. The cave held nests of *Collocalia fuciphaga*. Weights 21, 22, 22 gms.

Khajuria (1953:117) recorded four female examples of *T. melanopogon* from the Andaman Islands.

Taphozous saccolaimus crassus Blyth

Taphozous crassus Blyth, 1844, *J. Asiat. Soc. Beng.* **13**: 491. Mirzapore, Allahabad, India.

1 ♀ No. 9. Campbell Bay, Great Nicobar Island. 4th March, 1966. Clearing on edge of high forest along seashore.

Taphozous saccolaimus has not been recorded hitherto either from the Nicobar Islands or from the Andaman Islands. This specimen has pale brown underparts, lightening to white on the flanks immediately beneath the insertion of the wing membrane, which has a narrow band of short white hairs on its ventral surface behind the forearm. The specimen is darker ventrally than pale-bellied examples formerly referred to *affinis* (=*saccolaimus*) but has much paler underparts than dark-bellied specimens characteristic of *saccolaimus* as formerly understood.

Megaderma spasma (Linnaeus)

Vespertilio spasma Linnaeus, 1758, Syst. Nat. ed. 10, **1**: 32. Ternate, Molucca Islands.

1 ♀ No. 84. Wrightmyo, South Andaman Island, 15th February, 1964. Flew into room in the Forest Bungalow.

There is no previous record of *M. spasma* from either the Andaman Islands or the Nicobar Islands and it is difficult to allocate this specimen to any one of the described subspecies. In colour it closely resembles *M. s. majus* (Burma), *M. s. minus* (Thailand, Indochina), and *M. s. trifolium* (Sumatra, Java, Borneo). In length of forearm (56.9 mm.) it agrees with *M. s. horsfieldi* (India), *M. s. ceylonense* (Ceylon), *M. s. medium* (Tenasserim, Malay Peninsula), and *M. s. trifolium* but it has a very large skull (greatest length 27.0 mm., c—m^3 10.4 mm., length of mandible 17.9 mm.), in this respect agreeing more closely with *M. s. majus*. These circumstances suggest that subspecific designation should be deferred until more adequate series of specimens from the Andaman Islands and from near-by territories are available.

Rhinolophus andamanensis Dobson

Rhinolophus andamanensis Dobson, 1872, *J. Asiat. Soc. Beng.* **41**, 2: 337. South Andaman Island.

Ellerman and Morrison-Scott (1951:114) pointed out that *R. andamanensis* is very like *R. affinis* and may represent that species in the Andaman Islands.

Rhinolophus cognatus cognatus Andersen

Rhinolophus cognatus Andersen, 1906, *Annali Mus. civ. Stor. nat. Giacomo Doria,* (3), **2**: 181. Port Blair, South Andaman Island.

Rhinolophus ? cognatus famulus Andersen

Rhinolophus famulus Andersen, 1918, *Ann. Mag. nat. Hist.* (9), **2**: 377. North Central Island, Andaman Islands.

There seems little doubt that *famulus* is but subspecifically related to *cognatus*, differing chiefly in smaller size (Andersen, 1918:377).

Hipposideros diadema nicobarensis (Dobson)

Phyllorhina nicobarensis Dobson, 1871, *J. Asiat. Soc. Beng.* 40, **2**: 262. Nicobar Islands.

6 sex undetermined Nos. 18-23. Trinkut, Middle Nicobar Islands. 20th March, 1966. Cave on seashore. Collected by B. R. Grubh and P. B. Shekar.[1]

Hitherto, *H. d. nicobarensis* appears to have been represented in collections solely by the type specimen, a female in alcohol, collected by Dr. Stoliczka and preserved in the Indian Museum, Calcutta. So far as can be determined from the dry specimens, they conform closely to the original description. This is the smallest of the described subspecies of *H. diadema*, the length of the forearm in fact equal only to that of *H. larvatus*, from which *H. d. nicobarensis* is readily distinguished by its much larger skull. Minimum, maximum and mean (in parentheses) measurements in millimetres of six specimens (except where stated):

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[1] Society's staff members who accompanied Mr. Abdulali—EDS.

length of forearm 58.8-64.2 (62.2); condylocanine length (five specimens) 22.6-22.9 (22.7); width of rostrum 7.8-8.1 (8.0); interorbital width 3.3-3.4 (3.3); zygomatic width 14.5-15.0 (14.7); mastoid width (five specimens) 12.4-13.0 (12.7) and c—m^3 9.7-10.0 (9.9). Despite the comparatively small size of *nicobarensis,* there is no reason to doubt its allocation to *H. diadema* as a subspecies. There is no antitragal projection and the anterior noseleaf lacks any definite median emargination. The posterior noseleaf is high and is supported by a median septum, the upper part of the leaf wide and folded anteriorly over the intermediate part of the leaf. The dorsal pelage is soft and dense, the hairs tricolored, dark brown at the base, centrally grey and tipped with brown. For the most part, the ventral pelage is similar in colour but the hairs are paler at the base and are less evidently tipped with brown, especially towards the flanks. On the extreme anterior part of the chest and on the throat the hairs are grey white throughout their length. Laterally, along the flanks beneath the junction of the wing membrane and the body the hairs are dark brown at the base but otherwise are grey white, without any brown tipping, the white element in some specimens extending in front of the junction of the antebrachial membrane with the body to form a small white tuft. There is often a further white patch on the flanks above the junction of the anterior part of the wing membrane and body, at the base of the forearm. Cranially, the sphenoidal bridge is wide and the pterygoids expanded as in *H. diadema.* In its comparatively very small size this subspecies forms an exception to the general rule (Hill, 1963:108) that the larger subspecies of *H. diadema* are to be found in the western parts of its range and the smaller subspecies in the easterly areas of its distribution.

Hipposideros ater nicobarulae Miller

Hipposideros nicobarulae Miller, 1902, *Proc. U. S. natn. Mus.* **24**: 781. Little Nicobar Island.

3 ♂♂ Nos. 7, 8, 12; 4 ♀♀ Nos. 5, 6, 10, 11. Campbell Bay, Great Nicobar Island. 4th March, 1966. Cave on seashore.

1 ♂ No. 25. Camorta Island, Middle Nicobar Islands. 29th March, 1966. In old Japanese anti-aircraft box.

1 ♂ No. 31; 2 ♀♀ Nos. 32, 33. Car Nicobar Island. 7th April, 1966. Cave near seashore.

One specimen (No. 5) is in the rufous phase, in contrast to the remainder in the greyish brown phase.

(?) Hipposideros fulvus fulvus Gray

Hipposideros fulvus Gray, 1838, Mag. Zool. Bot. 492. Dharwar, India.

Hipposideros murinus Gray, 1838, Mag. Zool. Bot. 492. Dharwar, India.

Blyth (1846:368) recorded *H. f. fulvus* (as *H. murinus*) from the Nicobar Islands. Externally, it is very like *H. ater* although rather larger and it is possible that this record refers to *H. a. nicobarulae.*

Myotis (?) adversus dryas Andersen

Myotis dryas Andersen, 1907, *Annali Mus. civ. Stor. nat. Giacomo Doria,* **(3), 3**: 33. Port Blair, South Andaman Island.

Ellerman and Morrison-Scott (1951:149) tentatively listed *dryas* as a subspecies of *M. adversus.*

Pipistrellus javanicus camortae Miller

Pipistrellus camortae Miller, 1902, *Proc. U.S. natn. Mus.* **24**: 779. Camorta Island, Nicobar Islands.

4 ♀♀ Nos. 1-4. Great Nicobar Island. 3rd March, 1966. Clearing on edge of high forest along seashore.

1 sex undetermined No. 17 (subadult). Camorta Island, Middle Nicobar Islands. 13th March, 1966. In clearing in forest.

These specimens are referred to *camortae* without direct comparison but agree closely with the original description. Their close resemblance to *P. javanicus* indicates that *camortae* should be considered no more than subspecifically related to this species. They are rather smaller than *P. j. javanicus* from Java with the minimum, maximum and mean (in parentheses) length of the forearm in four specimens 31.3-32.7 (31.8) mm. and c—m^3 4.7, 4.7 and 4.6 mm. In length of forearm they resemble *P. j. paterculus* from Burma but have larger and more massive teeth. The specimen from Camorta Island has dark brown dorsal pelage with the ventral pelage of similar but slightly paler colour. Those from Great Nicobar Island have dorsal pelage that is darker and more blackish brown: the ventral pelage, although paler, is a darker brown than in the example from Camorta. This specimen is very slightly darker both dorsally and ventrally than *P. j. javanicus* and approaches the palest of *P. j. paterculus* in colour but the specimens from Great Nicobar agree exactly with the darker specimens of this subspecies. Earlier records of *P. abramus* (Dobson, 1876:212; J. Anderson, 1881:129) and of *P. tenuis* (Zelebor, 1869:16) may be based upon specimens of *P. j. camortae. Vesperugo nicobaricus* Fitzinger (1861:390, nom. nud.) refers to the record subsequently regarded as *P. tenuis* by Zelebor.

Hesperoptenus tickelli (Blyth)

Nycticejus tickelli Blyth, 1851, *J. Asiat. Soc. Beng.* **20**: 157. Chaibassa, Orissa, India (Wroughton, 1918: 22).

1 ♂ No. 22. Wrightmyo, South Andaman Island. 11th February, 1964. On the border of mangrove and forest.

1 ♂ No. 214. Long Island, Middle Andaman Islands. 27th February, 1964. Over seashore and maidan, near town.

1 ♀ No. 230. Long Island, Middle Andaman Islands. 28th February, 1964.

These specimens agree closely with specimens from Ceylon in size and colour: like these they are a little darker and more richly coloured dorsally than are the majority of Indian specimens. Dobson (1876:208) and J. Anderson (1881:132) recorded *H. tickelli* from the Andaman Islands.

Tylonycteris pachypus fulvida (Blyth)

Scotophilus fulvidus Blyth, 1859, *J. Asiat. Soc. Beng.* **28**: 293. Schwegyin, River Sittang, south-eastern Burma.

1 ♂ No. 128. Wimberleyganj, South Andaman Island. 17th February, 1964. Over dry ricefield. Weight 3.5 gms.

This specimen has a damaged skull but agrees in colour with *T. p. fulvida,* to which it is referred provisionally. Dobson (1876:116, 210) and J. Anderson (1881:126) recorded a series of Andamanese specimens of *T. pachypus.*

Scotophilus temminckii (Horsfield)

Vespertilio temminckii Horsfield, 1824, Zool. Res. Java, pt. 8, pl. 9. Western Java (Sody, 1936: 48).

Recorded from the Nicobar Islands by Blyth (1863:354). There appear to be no subsequent records.

Miniopterus australis pusillus Dobson

Miniopterus pusillus Dobson, 1876, Monogr. Asiat. Chiroptera, 162. Nicobar Islands (Wroughton, 1918: 22).

The collection of the British Museum (Natural History) contains specimens from Katchal Island, Nicobar Islands, whence it was recorded by J. Anderson (1881:146). Presumably the subsequent reports by A.R.S. Anderson (1903:164) (as *M. schreibersi*) and Seymour Sewell (1922:979) refer to this bat.

BATS RECORDED FROM THE ANDAMAN ISLANDS:

Pteropus melanotus melanotus
Pteropus (?) *hypomelanus satyrus*
Pteropus vampyrus
Pteropus giganteus
*Cynopterus brachyotis brachysoma**
*Taphozous melanopogon melanopogon**
*Megaderma spasma.**
Rhinolophus andamanensis
Rhinolophus cognatus cognatus
Rhinolophus (?) *cognatus famulus*
Myotis (?) *adversus dryas*
*Hesperoptenus tickelli**
*Tylonycteris pachypus fulvida**

---

* Obtained by Mr. Abdulali

BATS RECORDED FROM THE NICOBAR ISLANDS:

Pteropus (?) *melanotus tytleri*
*Pteropus faunulus**
Pteropus vampyrus
*Cynopterus brachyotis scherzeri**
*Taphozous saccolaimus crassus**
*Hipposideros diadema nicobarensis**
Hipposideros ater nicobarulae
(?) *Hipposideros fulvus fulvus*
*Pipistrellus javanicus camortae**
Scotophilus temminckii
Miniopterus australis pusillus

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* Obtained by Mr. Abdulali.

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A new Species of *Christisonia* Gardn. from South India

BY

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(*With a plate*)

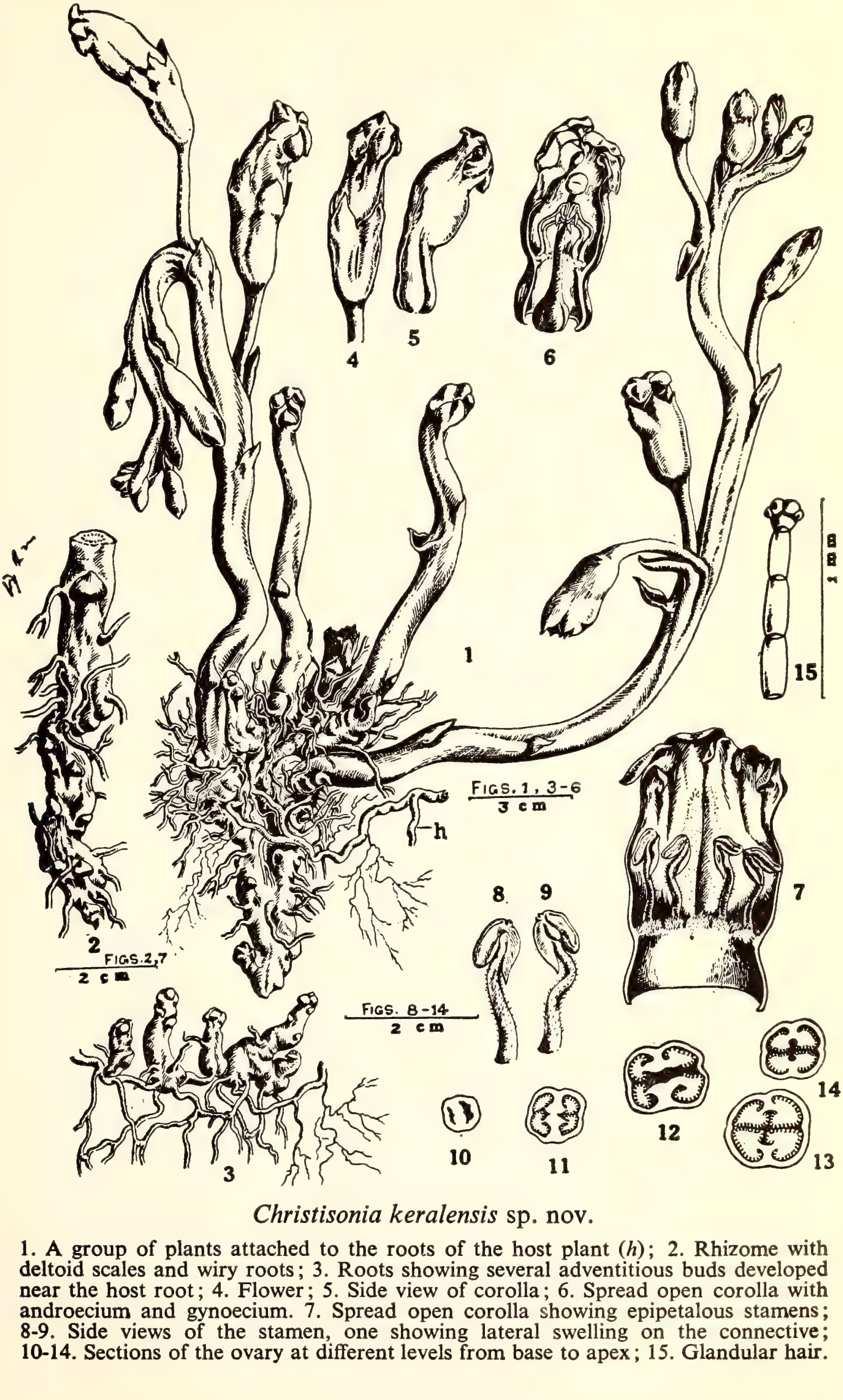
A new species, *Christisonia keralensis*, which comes near *C. saulieri* Dunn is described. It is based on a study of living specimens collected at Nelliyampathi Hills in the Western Ghats, Kerala State, South India.

The plant forming the subject of this paper was found growing at Nelliyampathi in the Western Ghats at an altitude of about 500 metres. It was first collected by the author in August 1960 and subsequently in September 1965. The plant seems to be a new species of *Christisonia* Gardn. and a description of it based on a study of living specimens is given below.

Christisonia keralensis sp. nov.

Plantae erectae, haud virides, parasitantes *Ficus asperrimae* radices. Radices plures, filamentosae, profuse ramosae, ad 1.5 mm. crassae. Rhizoma 2-8 cm. longum, ad 1.2 cm. crassum, irregulariter cylindricum, fusco-brunneum, vulgo non furcatum, ornatum foliis minutis squamosis sparsis, quae progressive maiora evadunt supra. Inflorescentia solitaria et terminalis vel raro bina ternave emergens ex axillis squamarum; racemus 5-10-florus. Pedunculi 20-30 cm. longi, ad 1.2 cm. crassi ad basin, gradatim fastigati versus apicem, glabri et pallide brunneo-rosacei. Bracteae 1-1.5 cm. longae, 5-8 mm. latae, pallide brunneo-rosaceae, glabrae, inferiores quidem steriles et deltoideae, superiores fertiles et ovatae. Pedicelli 1.5-3 cm. longi, ad 3 mm. crassi, vulgo erecti et brunneo-rosacei. Flores 3.5-5 cm. longi, ebracteolati. Calyx 2.5-3.8 cm. longus, 1.2-1.5 cm. latus, glaber, pallide brunneo-purpureus. Corollae tubus 3.5-5 cm. longus, 1-1.3 cm. latus, products longe supra calycis lacinias, cremeo-albus, glanduloso-pilosus in utraque pagina, gutture luteolo tincto aurantiace, lobis 0.8-1 cm. latis, nitenter violaceis, orbiculari-reniformibus. Stamina 4; filamenta pallide purpurea, glanduloso-pilosa per totam longitudinem; antherae pallide purpureae, bicellulares, una cellula fertili, ovata et ad apicem minutim mucronata, altera vero sterili falcata paulo longiore sed graciliori minutim subulata ad apicem, acute calcarata ad basin, calcare extus curvato; connectivum eminenter tumescens ad

Erady: *Christisonia keralensis*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FIGS. 1, 3-6
3 cm
FIGS. 2, 7
2 cm
FIGS. 8-14
2 cm
1 mm

Christisonia keralensis sp. nov.

1. A group of plants attached to the roots of the host plant (*h*); 2. Rhizome with deltoid scales and wiry roots; 3. Roots showing several adventitious buds developed near the host root; 4. Flower; 5. Side view of corolla; 6. Spread open corolla with androecium and gynoecium. 7. Spread open corolla showing epipetalous stamens; 8-9. Side views of the stamen, one showing lateral swelling on the connective; 10-14. Sections of the ovary at different levels from base to apex; 15. Glandular hair.

unum latus; pollinis grana 23-25 μ longa, 50-70 μ lata, ovoidea parietibus levibus. Ovarium uniloculare; ovula 180-200 μ longa, 125-150 μ lata; stylus glaber inclusus, sed attingens supra antheras, stigma peltatum.

Typus lectus in Kerala, in India meridionali, in montibus Ghat Occidentalibus ad altit. 500 m. ab N.A. Erady die 17 Aug. 1960 et positus in herb. Govt. Coll. Victoria ad Palghat sub numero 1117.

Erect, non-green herbs, parasitic on the roots of *Ficus asperrimae* Roxb. *Roots* very numerous, wiry, profusely branched, up to 1.5 mm. thick, with irregular swellings at the place of contact with the host roots and developing many adventitious buds. *Rhizome* 2-8 cm. long, up to 1.2 cm. thick, irregularly cylindrical, dark brown, usually unbranched with small sparsely arranged deltoid scale leaves, which become progressively larger above. *Inflorescence* solitary and terminal, or rarely 2-3 arising from the axils of scale leaves; raceme 5-10-flowered. *Peduncles* 20-30 cm. long, up to 1.2 cm. thick at the base, gradually tapering towards the apex, glabrous and light brownish pink. *Bracts* 1-1.5 cm. long, 5-8 mm. broad, light brownish pink, glabrous, lower ones sterile and deltoid, upper ones fertile and ovate. *Pedicels* 1.5-3 cm. long, up to 3 mm. thick, usually erect and brownish pink. *Flowers* 3.5-5 cm. long, ebracteolate, bisexual, hypogynous and zygomorphic. *Calyx* 2.5-3.8 cm. long, 1.2-1.5 cm. broad, glabrous, light brownish pink, tubular campanulate with slight median zygomorphy, tube split at the top to one third the length into 5 subequal triangular valvate lobes with acute apex. *Corolla* tube 3.5-5 cm. long, 1-1.3 cm. broad, prolonged much above the level of the calyx lobes, slightly bent towards the anterior side, creamy white, glandular hairy on both sides, lower half closely appressed to the ovary, upper half inflated; throat yellowish with a tinge of orange; tube expanding into a sub-bilabiate 5-lobed limb; lobes 0.8-1 cm. broad, bright violet, orbicular reniform, imbricate, anterior three lobes somewhat equal and slightly smaller than the posterior lobes. *Stamens* 4, inserted at the constricted part of the corolla tube, included, imperfectly didynamous; filaments light purplish, glandular hairy throughout; anthers pale purplish, two-celled, one of the cells fertile, ovate and with a short minutely subulate apex, dehiscing longitudinally, the other cell sterile, falcate, slightly longer than the fertile cell but thinner, apex minutely subulate, base sharply spurred with tip curved outwards; connective with a prominent swelling on one side; pollen grains 23-25 μ long, 15-17 μ broad, ovoid and with smooth wall. *Ovary* of 2 median carpels, syncarpous, superior, unilocular with a tendency to become bilocular at the base; placentae 2, parietal, bipartite, tips expanding into fleshy portions; ovules 180-200 μ long, 125-150 μ broad, numerous, anatropous and arising from the entire surface of the placenta; style glabrous, included but reaching above the level of the anthers; stigma peltate and with a narrow depression in the centre.

Of the 10 species of *Christisonia* with ebracteolate flowers included in the section *Euchristisonia* by Beck Mannagetta (1930), only *Christisonia saulieri* Dunn shows some resemblance with this plant.

ACKNOWLEDGEMENTS

The author's sincere thanks are due to Rev. Fr. Dr. H. Santapau for rendering into Latin the diagnosis of the new species and for suggestions in the preparation of this note and to Sri R. Vasudevan Nair for providing the Indian Ink Drawings.

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Epilogue on a Sind Lake

BY

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Manchar Lake in the north-western region of former Sind Province has long been famous amongst sportsmen as the winter haunt of vast flocks of waterfowl. In the New Year of 1928 it was visited by Dr. Sálim Ali, and his vivid account of the birdlife and of the fascinating methods used by the local fishermen or Mohannas to hunt and capture fish and fowl from the lake waters, remains on record in Volume **32**(3) of this *Journal.* I hope therefore that it will be of interest to record the impressions of a visit to the lake some thirty-eight years later.

In 1928 the main irrigation scheme in Sind, emanating from a huge barrage across the Indus River at Sukkur, was not yet completed and it was feared that the whole lake, which depends on a natural seepage channel from the Indus River downstream of Sukkur, would ultimately be drained in order to augment the fertile acres which were already cultivated around the margins of Manchar as the summer floods receded. Though, there has been no deliberate drainage scheme, these fears have proved only partly unfounded as several major irrigation schemes on the Indus and its tributaries upstream of Manchar have served to decrease the flow of water which annually feed this lake which is now much reduced in area, and overgrown with reeds.

Even today, Manchar is still relatively remote and difficult of access to the outside visitor and though I had often wished to see the lake, which is reputed to be the biggest fresh water body on the sub-continent, it was not until December 1965 that an opportunity arose, when I was invited to join a small shooting party. Having occasionally heard first hand reports of persons who had visited Manchar, and being a witness to the alarming decline of many migrant bird species during the past fifteen years that I have lived out here, I was fully prepared for disappointments. Nevertheless I was shocked to find such small numbers of certain water fowl species as the following account will reveal.

Approaching Manchar via the railway line that runs along the west bank of the Indus, our party detrained at the historic old town of Sehwan, famous as the burial place of a Holy Saint[1] and a place of pilgrimage. From here we travelled about eight miles by Landrover over an incredibly bad and dusty track to the village of Bubak which squats on a slight hill overlooking the earthen embankment which was built some six years ago to contain summer inundations from Manchar's eastern banks. Arriving at Bubak around 3.30 p.m. we were greeted by the twitter of Common Sandgrouse flighting overhead and the staccato call of Grey Partridges from the tamarisk scrub nearby. My companions being keen sportsmen, immediately set off to walk up the partridges whilst I attempted in the Landrover to reach the lake shore. After penetrating for about three miles inside the area of the embankment, I could still see only a distant fringe of reeds and no water. All the surrounding land was being cultivated with wheat which was irrigated by lift irrigation from a canal flowing from the lake. Judging from the few surrounding trees it did not look as though the area had been subject to more than the briefest flooding, if at all, in recent years. Apart from numerous flocks of Starling (*Sturnus vulgaris*) probably mixed flocks of the races *nobilior* (observed by Dr. Sálim Ali) and *poltaratskyi*, I saw no Black-tailed Godwit which I was expecting, but instead three or four large flocks of Dusky or Spotted Redshank (*Tringa erythropus*), feeding in the young wheat or turning and wheeling in tight flocks in the evening sun. In the Punjab I have observed the Dusky Redshank in small numbers only and mainly as an October and April passage migrant at which times many individuals are in the dark plumage of the summer season. I was later to observe that this wader was the dominant species around the fringes of Manchar and that it is also extremely plentiful in other jheels in northern Sind. Returning to the rest house, I walked along a small drainage channel fringed with tamarisk bushes and here and there by clumps of sedges and reeds. Besides the usual Whitecheeked Bulbul, Striated Babbler (*Turdoides earlei*), Common Snipe (*Capella gallinago*) and Moorhen (*Gallinula chloropus*), I was pleased to get very good views of Painted Snipe (*Rostratula benghalensis*) and Whitebreasted Waterhen (*Amaurornis phoenicurus*). Both are species of very local distribution even in northern Sind and are very seldom encountered at all in the Punjab. The Whitebreasted Waterhens were noisy and quarrelsome, whilst a male Painted Snipe fascinated me by bobbing its tail up and down like a Common Sandpiper (*Tringa hypoleucos*), a habit which I have not seen described in books. On my approaching very close it sank into the half submerged grass until its bill and entire wings were under water and only its striped crown and dark beady eye remained visible.

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[1] Qallandar Lal Shah Baz—Mayne, P.; Saints of Sind—J. Murray.

Our plan was to set off from the rest house at 3.00 a.m. the next morning; to travel by house boat down a canal which leads to the lake, and near its shores to embark on separate small punts from which the various guns in a spread out line would be able to shoot at whatever ducks were moving around at sunrise. Since my idiosyncrasies were well understood by the shooters, it was agreed that I should take my punt in an opposite direction to explore with my binoculars as much of the lake as possible. As companions I had two Mohannas who took turns to pole the little vessel across the water. It was bitterly cold and still quite dark when we transferred to these smaller boats and as we passed between flimsy walls of reeds, I crouched in the bottom of the boat trying to keep my knees and wrists warm, listening to the weird cries of the jacanas and stuttering squawks of the Purple Moorhens (*Porphyrio porphyrio*) which rose noisily at our approach, their huge trailing feet clearly visible even in the darkness. After travelling between these reeds for nearly a mile and at the first glow of dawn, I separated from the others and we entered upon the open water. Even before the red rim of the sun broke the greying skyline, I was aware of bird life all around. Dozens of hovering Pied Kingfishers (*Ceryle rudis*) flew round the boat and as the sun rose, about twenty Common Swallows (*Hirundo rustica*), skimmed the disturbed lake surface of our now molten wake as though drawn along by our boat. Collared Sand Martins (*Riparia riparia*) were hawking higher in the sky, and as the sun gilded the reeds, the skies were criss-crossed by small flights of Common Teal, skeins of Little Cormorants (*Phalacrocorax niger*) and the occasional solitary heron.

The boatman told me that Manchar is 24 miles long and 12 miles wide. During the course of that day, we crossed the lake from shore to shore and traversed for several miles along the western shore. Allowing for the shimmering distortion of distant objects and visibility in such surroundings, I do not think the lake today is more than six miles broad by eight to ten miles long. On its western banks it is flanked by the low ochreous foot hills of the Kirthar Range and on the eastern bank, by which we had entered, there is at least a three-quarter mile wide fringe of reeds. The lake is nowhere deeper than 5 to 6 feet now and is clogged with a dense growth of water weed (possibly *Limnophila heterophylla*), and in isolated patches the rope-like strands of what looked like *Urticularia stellaris*. Here and there solid clumps of tall rushes stand out like islands, and in many stretches the surface of the weed-clogged waters are also carpeted with an orange brown algal growth which, together with the underlying weed, affords sufficient support for Little Stints (*Calidris minutus*) and numerous Yellow Wagtails (*Motacilla flava*) to run about the surface and even in certain places to support Pheasant-tailed Jacanas (*Hydrophasianus chirurgus*) and Paddy Birds (*Ardeola grayii*). Apart from the many boats which we encountered moving in different directions, we passed four floating villages or collections of house boats complete with cooking fires and tethered chicken. It appears that population pressure has increased even the number of Mohannas who make a living on the lake. I was told that about twenty maunds of fresh fish are daily despatched by bullock cart to the railhead at Sehwan and that in some seasons many times this quantity, and that this is the main source of livelihood, as hardly a couple of dozen coots and ducks are captured daily. The fish which, I saw caught, seemed to comprise of three species only. Two were carp (probably *Rohu* and *Mirgal*[1]), and the third with smaller scales a species of catfish (*Mori*). The old traditional methods of stalking the coots underwater, of shooting the coots with bows and arrows, and netting the duck in small purse nets (known as *Dhubi*) have been abandoned as there are no longer sufficient number of water fowl to make these techniques worthwhile. All my queries over two days and from various fishermen indicated that most of the duck were secured either by shooting or driving them at night into a net, which I saw suspended between poles and stretching for some five hundred yards across the lake. Due to dense weed growth, the fish are mostly caught by baited hooks attached at intervals by short leaders to a long line, which floats on the surface of the water weed and often stretches for 300 or 400 yards in a wide loop. Live fish of fingerling size are used to bait these hooks and the Mohannas keep numerous captive herons and cormorants for securing the fish used as bait. These captive birds are tethered by one leg to the small punts and taken to the shallows when required for fishing. One small punt which I photographed had a Large Egret (*Egretta alba*), a Purple Heron (*Ardea purpurea*) and a Grey Heron (*Ardea cinerea*) tethered to its gunwales, whilst another house boat had at least fifteen egrets and herons of various species plus five Little Cormorants (*P. niger*). The Large Egret seemed the most popular captive species possibly because of its size; it is distinctly bigger when seen alongside the Grey Heron. Surprisingly the Large Egret was also the most numerous and conspicuous of the many wild egrets and herons seen around the lake. In the early 1900's Ticehurst mentions having seen but few anywhere in Sind and even Sálim Ali only saw two pairs on Manchar. In contrast to the drastic decline in occurrence of nearly every other conspicuous species of water fowl, why should these have increased? The Little Cormorant was also a favourite captive but not the Paddy Bird or Cattle Egret, possibly because of their predilection for frogs instead of fish. I was surprised to see several captive Reef Herons (*Egretta gularis*). There was no trace of this species amongst the wild ardeidae and indeed I had never heard reports hitherto of its being observed more than 30 or 40 miles inland from the coast and that only during the monsoon season. On enquiries I found that large numbers come to Manchar during the summer particularly the early part, and I surmise that they follow the *Pala*, a species of Sea-herring which migrates to spawn in Manchar in huge numbers in March and April. Manchar must be quite 160 miles inland from the coast so this is an interesting record of its penetration. Though a fairly small bird the Reef Heron, was evidently preferred by the Mohannas over the larger Purple and Grey Herons. And here, I am tempted to digress momentarily to record that a closely allied species (*E. sacra*) spreads right across the south-west Pacific and I saw many specimens fishing off the Coral Reefs of the Solomon Islands last September and learned that it occurs there in both white and the usual slaty blue forms. Around Karachi *E. gularis*, occurs in a pale grey and very dark slate blue phase, as well as pure white specimens. This species presents a wonderful example of polymorphism which deserves further study.

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[1] These are the vernacular names.

Earlier writers have remarked on the callous cruelty with which the Mohannas keep wounded ducks as well as fish alive after capture, and there was further evidence of this in the method by which these captive herons and cormorants are prevented from fishing and so kept hungry until required to perform for their masters. The Little Cormorants I noticed had the gular pouch of their lower mandibles punctured and pulled up over the upper mandible so that the unfortunate birds are unable to open their mouths at all until the lower mandible is released. Similarly I saw Large White Egrets with their lower eyelids sewn by cotton thread and pulled over the eyes, the thread being drawn in a loop across the top of their crowns. Presumably the thread is cut and the eyelids released in the same way, when the birds are required for fishing.

By the end of the day I estimated, that unless vast numbers of ducks were hiding in the reed beds, not more than five or six thousand ducks of all species were around the lake. About a third of these were Mallard (*Anas platyrhynchos*) and teal which stuck to the reed beds and the eastern shore whilst the remaining two-thirds were White-eyed Pochards (*Aythya nyroca*) in separate flocks and again separate flocks of Common Pochard (*A. ferina*) mixed with about 15 to 20% Tufted Pochard (*A. fuligula*). Mallard and White-eyed Pochard were undoubtedly the two dominant species and I did not identify any Pintail (*Anas acuta*) or see a single Redcrested Pochard (*Netta rufina*), two species which I had been told were generally quite numerous on Manchar. On the western banks in the reedy shallows I also put up a number of small groups of Shovellers (*A. clypeata*) and there might have been three or four hundred of this species. But nowhere were there any solid black flock of water birds such as were encountered by Sálim Ali, and in fact there are many smaller jheels in Sind which harbour ducks in several hundred thousands as my hunter friends later testified. It is noteworthy that 1965-66 has been one of the worst drought years in the past forty years in the Indus water-shed. Few inundation jheels or suitable feeding places being available, ducks had concentrated in unbelievable swarms on the few large and permanent bodies of water. The small numbers on Manchar are therefore all the more remarkable. But it is the virtual disappearance of the coot which saddened me. In 1914 Ticehurst described the phenomenal numbers of coots which swam on Sind lakes, and stated that flocks could be measured not in acres but in square miles. Whole villages lived on the trapping and sale of these unfortunate birds for meat and at the same time they attracted a great concourse of raptors. Even in 1928 Sálim Ali averred that the taking of 1000 to 2000 daily seemed to make no impression whatsoever on their numbers. Apart from observing three or four small flocks of a dozen up to one hundred individuals, I saw but one large flock on the whole lake, and this far from covering acres was a mere black ribbon numbering perhaps 3000 birds. In this Continent the lowly coot has probably escaped large scale ringing operations, and I am not aware of their main breeding grounds. All West Pakistan birds are winter visitors though a few stragglers have been observed to summer in the foothill regions. I suspect that a good number breed in the swamps of Seistan as Punjab does not receive such numbers as Sind has always done. Seistan is being rapidly dried up by new irrigation and hydroelectric schemes and from what little I have read about Russian developments, there have similarly been many new Dams and Hydroelectric schemes in Asiatic Russia. Perhaps the resultant ecological changes have done more to reduce the coot population than even the ruthless hunting of the Sindhis.

Having a well illustrated bird book with me, I could show various pictures to the boatmen who evinced a keen interest in the pictures, and I was able to cross examine them about the occurrence of many bird species known to frequent the lake and add this to my own observations. I saw no Painted Storks though they were seen in August of this year in small numbers on Manchar by a bird watching friend. I saw no Black Ibis (apparently common in 1928) or storks of any species. Pelicans still visit Manchar but according to my boatmen only in very small numbers. I saw none. Common and Demoiselle Cranes and even Spoonbills are very seldom seen. On the western bank I did see three or four small groups of Glossy Ibis (*Plegadis falcinellus*) feeding amongst the sedges and the largest flock numbered thirty-five birds. On the main body of the lake itself the two most conspicuous birds were Pheasant-tailed Jacanas and Whiskered Terns (*Chlidonias hybrida*). The latter were fishing everywhere and must have numbered three or four hundred individuals. Perhaps the thick weed makes conditions unsuitable for diving species of terns. Certainly I saw no Caspian Tern (the dominant species in 1928) and only 2 or 3 pairs of noisy River Terns (*Sterna aurantia*) and three or four Blackbellied Terns (*Sterna acuticauda*). The Whiskered terns probably feed on small molluscs, flies etc., as they capture their prey by suddenly dipping down to the water surface without actually plunging in. There were three or four small flocks of gulls which were predominantly Blackheaded Gulls (*Larus ridibundus*) with here and there a Brownheaded Gull (*L. brunnicephalus*) easily recognised by its wing tips. I saw only very few Slenderbilled Gulls (*L. genei*) which are usually the dominant species on the lakes of northern Sind.

Compared to the hundreds of thousands of Little Cormorants I have seen on other Sind lakes, there were comparatively few on Manchar. The weed-clogged water undoubtedly offers fish too easy an escape from the diving cormorants and moreover I have noticed that these birds seem to require prolonged periods of perching, to digest their food and dry out their plumage. The bare expanse of Manchar offers practically no suitable perch for webbed footed birds whereas many other Sind jheels are characterised by acres of flooded tamarisk bushes which are used by the Small Cormorants. I saw only one Darter (*Anhinga rufa*) and two Common Cormorants (*Phalacrocorax carbo*). Though I already knew from previous enquiries that flocks of geese no longer visited Manchar, this was corroborated by my boatmen who told me that for the past seven years they have deserted the lake entirely. What a sad contrast to the position as described in Sálim Ali's account.

But despite these disappointments my explorations afforded me many wonderful sights and two especial thrills. The first of these was a Little Bittern (*Ixobrychus minutus*). The Chestnut Bittern (*I. cinnamomeus*) is possibly the commonest species in Sind followed by the Yellow Bittern (*I. sinensis*) and then the Black Bittern (*D. flavicollis*) whilst the Little Bittern is by far the rarest. It is still fairly common as a breeding bird on the lakes around Srinagar as a friend of mine testified this summer, but in other parts of its range because of its extremely shy and skulking habits it is seldom if ever seen, though it is undoubtedly resident and breeding in Sind. We saw this delightfully trim little bird in a fairly small and open clump of sedges and rather than take to flight it froze in its characteristic upstretched stance, allowing me to guide the boat right around it and to study it from a few feet away. Its clumsy looking large olive green feet belied the agile manner in which it was able to clamber over and cling to the vertical reed stems. When put to flight it showed dull purplish black primaries and tail and being a female it had the forecrown also tinged with blue black. Either side of its neck and breast were heavily streaked with rich maroon while its mantle and scapulars were also streaked with a more browny chestnut. The rest of its body plumage was a buffy yellow.

The only common bird of prey was the Marsh Harrier (*Circus aeruginosus*) and there were considerable numbers of these circling low over the vast reed beds watching for an unwary Purple Moorhen. I saw but a single Osprey (*Pandion haliaetus*) and on the western shore a large dark eagle. Though it lacked any light spots on secondary wing coverts or white on the rump when put to flight, it was I think a Spotted Eagle (*Aquila clanga*). It was very dark which in my limited experience of this species is often the case though I have seen a captive specimen with pale golden crown and nape. A large dark eagle with comparatively long narrow wings flew low over the top of a reed bed with the obvious intention of surprising some Dabchicks (*Podiceps ruficollis*) feeding on the open water in its lea. It made two bold stoops but failed to capture anything. From its large size and comparatively long tail, and active manner I was sure it was an immature Bonelli's Hawk-Eagle (*Nisaëtus fasciatus*) though its breast was quite brown, thus making positive identification impossible.

The second thrill I had was, the sighting of a magnificent adult, Imperial Eagle, which I believe to be of the European race (*Aquila heliaca adalberti*). The Imperial Eagle seemed to come from nowhere and it swooped down on the main flock of coots. This caused so much panic that several birds rose into the air whereupon one was easily snatched from above by the eagle's powerful talons. This action was witnessed by all the fishermen in the vicinity who immediately set up a great din, banging their poles upon the water and shouting to frighten the eagle and make it drop its prey. This it did, perhaps by accident, as it swung in a wide arc and again picked the floating bird off the water and made for the nearest shore. As it did so, it was turning its head from side to side as though looking out for any further attacker. One wing of the unfortunate coot was caught in the eagle's retrices yet it did not in any way affect its powerful and direct flight. But no sooner had it come over the land when a Greater Spotted Eagle with white rump clearly visible also appeared from nowhere and swooped upon it. The Imperial Eagle dropped its quarry as it banked upwards to meet this new threat. Both eagles then alighted on the grass close by, where they seemed to crouch glowering at each other. The drama was however not yet ended, for a young boy from the nearest boat waded ashore and ran to where the coot had fallen. As the startled eagles flew away, I saw the boy triumphantly pick up the coot which from its flapping wings was still very much alive.

Having seen a Pallas's Fishing Eagle (*Haliaeetus leucoryphus*) in the distance some moments before, I at first assumed that the bird attacking the coots was the same species. Indeed I was able to see clearly that its entire crown and nape were a pale grey. But since Pallas's Eagles tend to have dirty buff white heads and necks this grey colour even then surprised me. Moreover the nape of Imperial Eagles which I have previously encountered were always a golden tawny colour but in all lights and angles this bird seemed to have a grey almost white nape and the most striking feature was the bright white shoulders and leading edge to the wings (lesser secondary wing coverts). When it exposed its full back view it showed no white scapulars of the typical eastern race of *A. heliaca*, but the white shoulder patches and forward edges of the wings were extremely conspicuous. Its tail appeared a pale grey buff again making me think it must be *Haliaeetus*, but it lacked any sharply contrasting terminal bar which I had clearly seen half a mile away on the other individual. Its overall plumage was a very deep almost purplish brown and when it rose to meet the Greater Spotted Eagle it was clearly a much larger, and heavier bodied eagle with broader wings. I also recall noticing its deep compressed bill with yellow cere and brown not white throat. Many years of bird watching have I hope taught me at least some humility in making identifications—particularly amongst the raptors and I have only decided after sifting my ' on-the-spot ' written notes, that this eagle could not have been *Haliaeetus leucogaster* (it was too large and had a dark brown breast) or *Icthyophaga ichthyaetus* (its tail was plain dirty buff all over without the central feathers being darker). *Haliaeetus albicilla* (which is not even included in Ripley's SYNOPSIS) has a wedge shaped tail and in any case lacks a whitish nape and *H. leucoryphus* has a bluish not yellow cere and white not brown throat. Last summer I was lucky to see a fine adult Imperial Eagle in a small zoo in North Wales which was undoubtedly *A. h. heliaca* the Asiatic race as it had conspicuous white scapular feathers, but its tail was quite dark grey barred with one or two broad grey brown bands and its wing shoulders were not noticeably light in colour. These are the sort of fascinating puzzles which make the sport of bird watching a perpetual challenge.

Even if my eagle did not conform to the books, it did provide in episodic form perhaps an explanation for the great decline in birdlife on Manchar Lake, for in the unequal struggle with mankind it is the birds that lose.

An annotated list of the Butterflies of Delhi, India

BY

JULIAN P. DONAHUE

[*Continued from Vol.* **63**(2): 269]

LYCAENIDAE

Tarucus nara (Kollar)

The Striped Pierrot is by far the most common of the four *Tarucus* in Delhi: large numbers of them can be collected by beating a thorny bush, possibly *Zizyphus* sp., when it is in flower on the Ridge. Only nine of the specimens have come from the Nursery, but the species is common at Tughlakabad. The flying time appears to be divided into two periods, based on the available records: Aug. II to Dec. IV, and Feb. III to May IV. 486 specimens: 326 males (67%), 160 females. The genitalia of all males have been examined.

Wynter-Blyth (1957) records *T. alteratus* Moore, a synonym of *T. nara*, from Delhi, but he was unable to tell me the original source for this record (pers. comm.). Longstaff (1912) reported collecting *T. theophrastus* in Delhi, 7-12 Nov. 1903, but since this is an African species he probably had *T. nara*, the most common Delhi *Tarucus*.

SIZE: Males and females vary from 9 mm. in the dry season to 12 mm. in the wet season.

VARIATION: The seasonal forms are strikingly different. Wet season specimens have large and dark markings on the underside, but in dry season specimens these markings become very much reduced and rusty. As Evans (1955) pointed out, the valvae of *T. nara* appear to be variable. In Delhi the genitalic variation appears to be associated with the season: dry-season forms have smaller lobes at the apex of the valva than do wet season specimens. An occasional " wet season " form has been collected during the dry season. These specimens are not only marked like wet season specimens, but they have the larger apical lobes on the valva associated with that form. Whether these specimens occur as a result of an undetermined environmental condition, or whether they actually represent a second species can only be ascertained after further study.

DISTRIBUTION: Because of the confusion in the genus prior to its revision by Evans in 1955, records published before that date cannot be heavily relied upon. Further, an examination of the male genitalia (the female genitalia have not been studied) is essential to a proper identification of most species of *Tarucus.* Evans (1955) lists the following localities in the plains of north-western India and Pakistan that are represented by specimens of *T. nara* in the British Museum (N.H.): Kutch and Kathiawar, Gujarat; Karachi, Pakistan; " Punjab," Ambala, Punjab; and " United Provinces." The species occurs south to Ceylon, east to Sikkim, and west to the Persian Gulf. There are additional specimens in the MSU collection from Amber, Rajasthan (15 November 1963, RLD) and Ludhiana, Punjab (11-12 Sept. 1961, JPD).

The *T. extricatus,* and *T. alteratus* in Wynter-Blyth (1957) are synonyms of *T. nara.*

Tarucus balkanica nigra Bethune-Baker

This rare species would probably have been missed entirely if long series of *Tarucus* had not been collected. Only four males have been obtained, plus a female that may be this species. As pointed out earlier, it is impossible to positively identify any *Tarucus* females except those of *T. callinara.* The genitalia of all four males were examined.

The only specimen from the Nursery was obtained on 3 Nov. 1962 (RCF), 10 mm. The other specimens, all from the Ridge, were taken on 21 Feb. 1963 (RCF), 10.5 mm.; 29 Feb. 1964 (RCF), 10 mm.; and 20 Aug. 1962 (JPD), 11mm. The doubtful female was collected on the Ridge, 14 April 1963 (RCF), 11mm.

Only one *nigra* was found in a series of about 35 *Tarucus* collected on the Ridge on 20 Aug. 1962.

Wynter-Blyth (1957) lists Delhi as a locality where this species occurs, but he was unable to tell me the original source for this record (pers. comm.).

DISTRIBUTION: For reasons stated earlier, published records of *Tarucus* cannot be relied upon, even for this species, the male of which is characterized by having black discal spots UPF. The following plains localities are represented by specimens in the British Museum (N.H.), as reported by Evans (1955): Karachi, Pakistan; Kutch (the type locality); Rajasthan; Punjab; Satna and Jabalpur, Madhya Pradesh; and " Dinapore, Bengal " (=Dinapore, Bihar or Dinajpur, East Pakistan?). It has been collected in the Himalaya from Peshawar and Baluchistan to Kumaon.

Tarucus indica Evans

An examination of the genitalia of all male *Tarucus* from Delhi yielded only two specimens of this species, which can be considered the rarest of the four Delhi *Tarucus.* If any females were collected, they are included in the account of *T. nara,* since no valid character of the facies could be found to separate the two.

Both specimens were collected on the Ridge by RCF. The first, a well marked specimen, was obtained on 26 Sept. 1963 (13 mm.). The spot at the end of the cell UPF is conspicuous (not inconspicuous as stated by Evans 1955). The second specimen, collected on 29 March 1964 (11 mm.), is worn: the upperside has very little blue, and the markings UPH resemble those of *Tarucus* females.

DISTRIBUTION: According to Evans (1955), specimens in the British Museum (N.H.) have come from Baluchistan to Kumaon in the Himalaya, and from Lahore and Karachi east to Bengal and south to Madras in peninsular India. Three males from Meerut, U.P. (35 miles NE. of Delhi), are the records nearest Delhi. The only other specimens in the MSU collection are three males from Ludhiana, Punjab, 12 Sept. 1961 (JPD).

Tarucus callinara Butler

The Spotted Pierrot is the only Delhi *Tarucus* whose female can be identified with a reasonable degree of certainty. It has been collected both on the Ridge and in the Nursery at scattered times throughout the year: Feb. I, March II, April II, Aug. I & II, Sept. I, Nov. III, and Dec. I & IV. 15 specimens: 5 males (33%), 10 females.

SIZE: The males and females vary from 9 mm. (Feb., Dec.) to 12 mm. (a Sept. ♀) and 13 mm. (a Nov. ♂).

DISTRIBUTION: Recorded from virtually throughout India by Evans (1955). He also records one male and six females from Delhi: T. G. Howarth and G. E. Tite of the British Museum (N.H.) found a male and three females in the B.M. collection, which are probably the specimens referred to by Evans. They are labelled "N. India, Delhi, Nov. 1932," [B.M. No. 1935-7].

Syntarucus plinius (Fabricius)

The Zebra Blue occurs in all habitats, but appears to be much more common in the Nursery. It is relatively rare during the dry season, but is especially abundant in November. It flies from Aug. IV to Jan. III, and Feb. IV to May IV. 123 specimens: 88 males (72%), 35 females.

SIZE: Males and females vary in size throughout the year, from 11 mm. to 13 mm.

DISTRIBUTION: This species is common throughout India and Pakistan (Cantlie 1962), and has been recorded on all sides of Delhi.

Azanus ubaldus (Cramer)

Only 12 specimens of the Bright Babul Blue have been examined. In the Nursery, a female was collected on 3 Nov. 1962, and males were collected on 17 and 22 Nov. 1962 (all by RCF). On the Ridge, a female was collected on 9 Aug. 1962 (JPD), five females on 20 Aug. 1962 (JPD), two males on 3 Nov. 1962 (RCF), and a male was collected there on 1 Dec. 1962 (RCF).

SIZE: Both sexes range from 9 mm. to 11 mm.

DISTRIBUTION: This species is found in India west to West Pakistan (Cantlie 1962). It has been recorded on all sides of Delhi.

Azanus uranus Butler

The Dull Babul Blue is the most common *Azanus* in Delhi. Although it is most common on the Ridge, five specimens have been collected in the Nursery, and one male was collected at the Najafgarh Jheel (RLD). It has only been collected from Nov. I to Dec. IV. 45 specimens: 32 males (71%), 13 females.

SIZE: Males and females vary from 8 mm. to 11 mm.

DISTRIBUTION: Reportedly common throughout India and Pakistan (Cantlie 1962).

Azanus jesous gamra (Lederer)

RCF has collected the only 10 specimens known from Delhi. They were all collected on the Ridge, as follows: two males and two females on 18 Nov. 1962, one male on 24 Nov. 1962, three males and a female on 1 Dec. 1962, and a male on 22 Dec. 1962.

These butterflies should be looked for near *Acacia* spp., for the flowers are fed upon by the larvae (Wynter-Blyth 1957).

SIZE: The males range from 9 mm. to 11 mm., while the females vary from 10 mm. to 12 mm.

DISTRIBUTION: The African Babul Blue is found throughout the more arid portions of India and West Pakistan (Cantlie 1962; Wynter-Blyth 1957), but de Rhé-Philipe (1902) failed to include it in the Lucknow list. MacPherson (1927) did not collect it in Jodhpur, nor did de Rhé-Philipe (1917) record it in Lahore. The published records nearest Delhi appear to be those of Aldrich (1946) in Kaira District, Gujarat, and Mosse (1929) in Kathiawar, to the south-west. However, there are specimens in the MSU collection from Siliserh, Rajasthan (19 Nov. 1963, RLD), and Amber, Rajasthan (15 Nov. 1963, RLD).

Chilades laius laius (Cramer)

The Lime Blue occurs sparingly in Delhi, and should be looked for in the vicinity of its foodplant, *Citrus* (Bell 1918). It has been seen or collected from July IV to Dec. IV (no October records) in the Nursery. One female was collected on the Ridge, Nov. I. 23 specimens: 13 males (57%), 10 females.

Longstaff (1912) collected this species in Delhi, 7-12 Nov. 1903.

The absence of tails is the major character that differentiates this species from *Euchrysops pandava pandava* (Horsfield), although the larvae reportedly have different foodplants: *E. pandava* feeds on cycads, according to Swinhoe (1910-1911). No significant differences were found when the genitalia of *C. laius* were compared with the genitalia of *E. p. pandava* from Karwar, Mysore and Darjeeling, West Bengal. The genitalia of both species resemble fig. 146 (*E. pandava*) in Corbet & Pendlebury (1956), except that the vinculum is narrower than they have drawn it. The valva of *E. pandava* has also been figured by Corbet (1941). The congeneric, or even conspecific, status of these two butterflies should be investigated.

SIZE: The males vary from 11 mm. to 13 mm., while the females range from 9 mm. (14 Nov. 1963, RLD) to 14 mm. (in August and September).

OVIPOSITION: On 19 Sept. 1961 two females were observed flying around a *Citrus* bush. At least one of them laid an egg on the bush.

On 26 July 1961 a female was observed flying around another *Citrus* bush. Eventually she landed on an irregular knob in the axil of a leaf and deposited an egg, rubbing her hind wings together as she did so. This process was repeated several times before I collected several of the twigs on which eggs had been laid. An examination of the irregularities on which the eggs had been deposited revealed that they were small clusters of aphids (Homoptera: Aphidae). The eggs failed to hatch, so it could not be determined whether the larvae would have fed on the *Citrus* (the recorded foodplant) or on the aphids. It appears that carnivorous behaviour has never been reported for this species (Clark 1926), although the larvae are attended by ants (Swinhoe 1905-1910; de Rhé-Philipe 1902).

DISTRIBUTION: The Lime Blue occurs throughout India (Cantlie 1962; Wynter-Blyth 1957), west to Jodhpur? (MacPherson 1927), Lahore (de Rhé-Philipe 1917), and Kathiawar (Mosse 1929).

Freyeria trochilus putli (Kollar)

The Grass Jewel is the smallest Delhi butterfly. It has been recorded from July IV to Dec. IV, and Feb. I. Although it is usually found in the Nursery, it has been collected at Tughlakabad and on the Ridge (1♂, Dec. I). 42 specimens: 27 males (64%), 13 females, 2 unsexed.

SIZE: Males and females vary from 6 mm. to 9 mm.

DISTRIBUTION: This subspecies, which does not have prominently orange-crowned marginal spots on the hindwing, occurs from south to north-east India. The nominate subspecies is found in West Pakistan (Cantlie 1962). One or two of the Delhi specimens have prominently orange-crowned marginal spots, thus indicating a tendency towards the Pakistan subspecies. The Grass Jewel has been recorded on all sides of Delhi.

Zizina otis indica (Murray)

The Lesser Grass Blue is common in Delhi, though it is not collected as frequently as *Zizeeria maha* and *Z. knysna*. Only two specimens have been collected during the monsoon (July IV, Aug. II); the rest have been collected from Nov. I to Feb. I and March IV to May III. It is most common in November and December. Systematic collecting would probably yield specimens from throughout the year. 74 specimens: 39 males (53%), 35 females.

SIZE: Males and females range from 8 mm. to 11 mm.

DISTRIBUTION: This subspecies occurs in peninsular India north to Sikkim and west to West Pakistan (Cantlie 1962). A second subspecies, *Z. otis sangra* (Moore), occurs from Sikkim and West Bengal east. The genitalic differences between the two " subspecies " have been noted by previous workers, who have retained the subspecific status of the two populations. The differences between the two, illustrated by Chapman (1910), would appear to be significant enough to warrant the recognition of two distinct species.

This butterfly has been recorded from Lucknow (de Rhé-Philipe 1902) and Lahore (de Rhé-Philipe 1917), but not from Jodhpur (MacPherson 1927). I have also collected it in Ludhiana, Punjab (11-12 Sept.

1961) and 15 miles south of Saharanpur, U.P. (8-9 May 1961). There are additional specimens in the MSU collection from Aligarh, U.P. (17 Nov. 1962 and 7 April 1964, RLD).

Zizeeria maha maha (Kollar)

Although the males of the Pale Grass Blue can be easily separated from males of *Z. knysna*, the females of the two species tend to overlap in size so that their identification becomes difficult. A good character to separate the two, in Delhi, is the arrangement of the discal spots UNF. In *maha* the spots in spaces 3, 4, and 5 are similar in shape, and the distal edges are more or less in line. In *knysna* the spot in space 4 is usually lengthened and oblique, and is shifted laterad from a line drawn through the spots in spaces 3 and 5.

This species has been recorded throughout the year, both on the Ridge and in the Nursery. It is most common in March and April, and again from late July through November. 223 specimens: 178 males (80%), 45 females.

SIZE: Males and females range from 10 mm. to 13 mm.

VARIATION: The seasonal forms are well-marked. The WSF occurs from July III to Oct. I, in which the males have the marginal band on the upperside much wider than in dry season specimens, accompanied by dark suffusion over the greater part of both wings. The females are dark brown above, with at most a trace of the basal blue. The DSF occurs during the remainder of the year (Oct. IV to June III), in which the males are pale lilac blue above, with narrow brown borders on both wings, and no suffusion. The DSF females have a varying amount of blue on the upperside—often as much as in a wet season male.

DISTRIBUTION: This subspecies is common from West Pakistan east to Assam and south to " Central India " (Cantlie 1962). Common in Lucknow (de Rhé-Philipe 1902) and Lahore (de Rhé-Philipe 1917), but MacPherson (1927) only records a few specimens from Udaipur, southern Rajasthan, and none from Jodhpur. There are, however, additional specimens in the MSU collection from Jaipur, Rajasthan (16-17 Nov. 1963, RLD), 170 miles ENE. of Jodhpur.

Zizeeria knysna karsandra (Moore)

The Dark Grass Blue is the most common of the Delhi grass blues. It occurs in the Nursery throughout the year, and is common on the Ridge from March IV to April IV, and again in November and December. It is most common in the Nursery during and after the monsoon. 463

specimens: 269 males (58%), 194 females. The sex ratio of field-collected specimens is apparently subject to great variation: of 76 specimens collected April II, only 38% were males, but of 67 specimens collected Aug. IV, 63% were males. A copulating pair was collected on 25 Sept. 1961 (JPD).

SIZE: Males and females range from 8 mm. to 11 mm.

DISTRIBUTION: This species is common throughout West Pakistan and India (Cantlie 1962; Wynter-Blyth 1957). Only a few specimens were collected in Lucknow by de Rhé-Philipe (1902), but it has been reported as common in Lahore (de Rhé-Philipe 1917) and Jodhpur (MacPherson 1927).

Zizula hylax (Fabricius)

This tiny butterfly has long been known as *Z. gaika* (Trimen), but Corbet (1940) has shown that the Fabrician name has priority. It is the least common of the Delhi grass blues, and is usually collected as single specimens from March IV to Dec. IV (no records for January, February, May, June, September, or October). Although the majority of specimens has been collected in the Nursery, three have been collected on the Ridge (March IV, Aug. III, Dec. IV), and five specimens were collected at Tughlakabad on 29 Sept. 1961 (JPD), indicating that it may be locally common during and after the monsoon. 23 specimens: 14 males (61%), 9 females.

SIZE: Males and females range from 8 mm. to 11 mm.

DISTRIBUTION: The Tiny Grass Blue occurs throughout India and Pakistan (Cantlie 1962; Wynter-Blyth 1957) and has been recorded on all sides of Delhi.

Euchrysops cnejus (Fabricius)

The Gram Blue has been found in the Nursery, on the Ridge, and at Tughlakabad. It flies from Aug. IV to Sept. IV, Nov. I to Dec. I, and Feb. III to March II. It has been most frequently collected in late February, early March, and early November. Longstaff (1912) collected it in Delhi, 7-12 Nov. 1903.

In the process of examining the genitalia of all males, it was found that the uncus of this species is quite different from that of the other two *Euchrysops* in India. 33 specimens: 25 males (76%), 8 females.

SIZE: Males and females range from 9 mm. to 15 mm., with the smaller specimens generally occurring during the dry season.

DISTRIBUTION: This species is common throughout India and Pakistan (Cantlie 1962). It has been recorded from Lucknow (de Rhé-Philipe 1902) and Jodhpur (MacPherson 1927), but not from Lahore (de Rhé-Philipe 1917).

Euchrysops parrhasius parrhasius (Fabricius)

The Small Cupid has long been known as *E. contracta* (Butler), but Corbet (1941) has shown that the *Hesperia parrhasius* of Fabricius actually refers to this species rather than to an *Everes* (the former *Everes parrhasius parrhasius* of south India is now known as *Everes lacturnus syntala* Cantlie). It occurs in all Delhi habitats, from July III to Nov. IV, Dec. IV, Jan. IV, and from March IV to May IV (not yet recorded in Feb. or June). 91 specimens: 62 males (68%), 29 females.

SIZE: Males and females vary from 9 mm. to 12 mm.

VARIATION: Males occurring from Nov. I to March IV are darker blue above than are males flying at other times. Females flying during the same period have a large amount of blue on the upperside, as opposed to July females, for example, which have only a few basal blue scales. The underside of these dry season specimens is very dusky, and the markings are greatly suffused and indistinct. The spot in space lc UNH is smaller than the spot in space 2, and a light postdiscal band is well-developed.

The dry season specimens appear to fit the description of *E. pandava minuta* Evans, a subspecies which is supposed to occur in Sind, Punjab, Baluchistan, and the N.W. Frontier (Cantlie 1962). But the genitalia of all males were examined and compared with the genitalia of specimens of *E. pandava pandava* (Horsfield) in the MSU collection from Karwar, Mysore and Darjeeling, West Bengal. No Delhi specimen had genitalia conforming to *E. pandava*, although it was noted that the genitalia of *E. pandava* are virtually identical to those of *Chilades laius*, q.v.

Corbet (1941) figures the valvae of *Euchrysops pandava*, *E. parrhasius parrhasius*, *E. cnejus*, and what he calls *E. parrhasius minuta* Evans. Unfortunately, the apparent transfer of *minuta* from *E. pandava* to *E. parrhasius* was not discussed, and no indication was given of the authority for the change.

Mr. G. E. Tite of the British Museum (Natural History) has been kind enough to examine Evans's type of *minuta*, and he informs me (pers. comm.) that *minuta* and *parrhasius* are one and the same species, thus confirming Corbet's (1941) observations. It appears, therefore, that *minuta* Evans only refers to the dry season form of *Euchrysops parrhasius parrhasius* (Fabricius), and is thus a NEW SYNONYM.

DISTRIBUTION: *E. parrhasius parrhasius* occurs from south India north to Nepal, west to Sind, Punjab, Baluchistan, and the N.W. Frontier (Cantlie 1962). It has not been recorded from Lucknow (de Rhé-Philipe 1902) or Lahore (de Rhé-Philipe 1917), although it has been recorded from Jodhpur (MacPherson 1927) and Kanpur, U.P. (Sanders 1955).

Catochrysops strabo strabo (Fabricius)

The Forget-Me-Not appears to be locally common but generally rare in Delhi. It occurs more or less throughout the year in all habitats: Jan. IV, March III & IV, May I & IV, Aug. IV, Sept. IV, and Nov. I to IV. The only place where it was found to be common was at Tughlakabad, where 27 males (no females) were collected on 29 Sept. 1961 (JPD). At other times in other localities only one or two specimens have been collected at any one time. 43 specimens: 37 males (86%), 6 females.

SIZE: Males and females vary from 13 mm. to 16 mm.

DISTRIBUTION: This subspecies is common throughout peninsular India (Wynter-Blyth 1957; Cantlie 1962; Tite 1959). It has been recorded in Lucknow (de Rhé-Philipe 1902) and Jodhpur (MacPherson 1927), but not in Lahore (de Rhé-Philipe 1917). There are additional specimens in the MSU collection from Ludhiana, Punjab (11-12 Sept. 1961, JPD) and Jaipur, Rajasthan (16 Nov. 1963, RLD).

Lampides boeticus (Linnaeus)

The Peablue is another of the most common Delhi butterflies. It has been recorded in all habitats throughout the year, except in the months of July and September. It appears to be most abundant from February to April and again in November, but it may have been heavily collected in the dry season when many species are not common, and may have been neglected for more desirable species during the monsoon, when more butterflies are flying. 312 specimens: 163 males (52%), 149 females.

SIZE: Males and females vary from 12 mm. in the dry season to 17 mm. after the monsoon.

DISTRIBUTION: This ubiquitous species is common throughout India and Pakistan (Cantlie 1962).

Prosotas nora ardates (Moore)

Only three males of the Common Lineblue have been examined, all of which were collected in Delhi by Leela R. Menon in October 1962 (11 mm.). The genitalia of all three specimens were dissected and compared with figures in Tite (1963), which should be consulted for information concerning the removal of this species from *Nacaduba*.

DISTRIBUTION: This subspecies occurs in Ceylon and throughout West Pakistan and India to Burma (Cantlie 1962; Wynter-Blyth 1957). It has not been collected in Lucknow (de Rhé-Philipe 1902), Sind (Menesse 1950), or Lahore (de Rhé-Philipe 1917), but MacPherson (1927) found it in Jodhpur, and Mosse (1929) collected it in Rajkot, Kathiawar, in December 1927. The foodplant is reported to be *Acacia caesia* (Wynter-Blyth 1957), so these trees should be more closely examined in Delhi.

Spindasis vulcanus vulcanus (Fabricius)

Only two males of the Common Silverline have been collected in Delhi. One was obtained by RLD in the Nursery on 28 Oct. 1962 (11 mm.), and the other was collected by RCF on the Ridge, 21 Feb. 1963 (12.5 mm.). The male genitalia of both this and the following species were examined and compared with the figures in Cantlie (1963).

DISTRIBUTION: This subspecies occurs throughout India and West Pakistan, except in the eastern Himalaya and Assam (Cantlie 1962; Wynter-Blyth 1957). It has been recorded from Lucknow (de Rhe-Philipe 1902), but not from Jodhpur (MacPherson 1927) or Lahore (de Rhé-Philipe 1917).

Spindasis ictis ictis (Hewitson)

Only eleven specimens of the Common Shot Silverline have been collected. Three males were collected in Delhi by Leela R. Menon in November 1962, while the rest of the specimens were collected on the Ridge: a male on 24 Feb. 1963, two males on 26 Feb. 1963, one male on 29 Feb. 1964, two males and a female on 11 March 1963 (all by RCF), and a female on 3 July 1962 (JPD).

SIZE: The males range from 12 mm. to 14 mm., while the females are 13 mm. and 14 mm.

DISTRIBUTION: This subspecies occurs locally throughout West Pakistan and India (Cantlie 1962; Wynter-Blyth 1957), but the only published record near Delhi is from Faizabad, U.P. (de Rhé-Philipe 1902).

Rapala iarbus (Fabricius) ssp.

Only four Delhi specimens of the Indian Red Flash, formerly known as *R. melampus* (Cramer), have been examined. Two males were collected in Delhi in November 1962 by Miss Nirmala (16 mm., 18 mm.), one male was collected in Delhi in December 1962 by Venu (17 mm.), and a female was collected in the Nursery by JPD on 29 May 1962 (15 mm.). This last specimen was collected as it sat on a *Citrus* leaf in the shade.

According to Cantlie (1962) the prominent orange-crowned spot in space 2 UNH of the Delhi specimens is indicative of *R. i. iarbus,* which presumably occurs from Nepal to Burma, but the paucity of orange scales in the tornal lobe UPH would indicate *R. i. sorya* (Kollar), which reportedly occurs from south India to Murree, Nepal, and Calcutta, and in Amritsar and Kanpur. Since the range of the latter subspecies encompasses Delhi, these specimens are probably referable to *Rapala iarbus sorya* (Kollar).

DISTRIBUTION: In addition to the ranges given above, specimens have been collected on Mount Abu (MacPherson 1927), in Kutch (Nurse 1899), and in Kathiawar (Mosse 1929). Menesse (1950) does not report its presence in Sind. Delhi appears to be on the western edge of the range of this species, at the latitude of Delhi.

LYCAENIDAE sp.

One male lycaenid was found in the Delhi material, labelled " Nursery, New Delhi, 26 Aug. 1961, JPD," which does not appear to be of Indian origin. Mr. G. E. Tite of the British Museum (N.H.) was not able to identify it because of its worn condition. Although anything is possible in biology, it is perhaps best to consider that this specimen was mislabelled during preparation.

NYMPHALIDAE

Charaxes fabius fabius (Fabricius)

The Black Rajah is an uncommon species in India, and Wynter-Blyth (1957) states that it has been recorded from Delhi, although he was unable to tell me the original source for this record (pers. comm.). No specimens or further records have been located, although the food-plant, tamarind (*Tamarindus indica*), occurs in Delhi.

DISTRIBUTION: According to Evans (1927) this subspecies is found in peninsular India north to Kangra and Sikkim in the Himalaya. In the plains of north-western India it has been recorded from Lucknow (de Rhé-Philipe 1902), Kathiawar (Mosse 1929), and in Kaira District (Aldrich 1946). Delhi appears to be on the western edge of the known, range of this species, which should be looked for near tamarind, at sugar, and on exuding tree sap.

Euthalia nais (Forster)

The only Delhi specimen known is in the I.A.R.I. collection, caught by Dr. M. G. Ramdas Menon on 2 April 1958.

DISTRIBUTION: The Baronet is locally common from Dehra Dun to Sikkim, south throughout peninsular India to Ceylon (Evans 1932, Wynter-Blyth 1957). South of Dehra Dun, the only record near Delhi is from Lucknow (de Rhé-Philipe 1902), where only one specimen (♂) was collected in March. Delhi is apparently the westernmost record for the species at this latitude.

Pseudergolis wedah (Kollar)

A single specimen in the I.A.R.I. collection, caught by Dr. M. G. Ramdas Menon, is the only known specimen from Delhi.

DISTRIBUTION: The Tabby is a Himalayan species, occurring from Kulu to Assam and Burma (Evans 1932; Wynter-Blyth 1957), and, since it has apparently not been previously reported south of the Himalaya, its occurrence in Delhi is exceptional and should be verified with further specimens.

Hypolimnas misippus (Linnaeus)

The Danaid Eggfly is a widespread species whose female mimics all three forms of *Danaus chrysippus* found in India. The typical female form, which is extremely difficult to distinguish from *D. chrysippus* in the field, is the only form which has been collected in Delhi. It is perhaps only a matter of time before the other two, more rare, forms are found. The species has been collected in the Nursery, on the Ridge, and at Tughlakabad, from June IV to Sept. IV, and Nov. I. 25 specimens: 17 males (68%), 8 females.

SIZE: ♂♂ 26 mm. (3 Nov. 1963, RLD) to 34 mm. (2 specimens, 28 Aug. 1961, JPD). ♀♀ 36 mm. (30 June and 29 Sept. 1961, JPD) to 41 mm. (4 Nov. 1961, JPD).

DISTRIBUTION: This butterfly occurs throughout India (Wynter-Blyth 1957), and has been recorded on all sides of Delhi. Interestingly, de Rhé-Philipe (1917) found this species less common than *H. bolina* in Lahore, while the converse is true in Delhi.

Hypolimnas bolina bolina (Linnaeus)

Although the Great Eggfly is common in many parts of India, it is rare in Delhi. Only four females have been collected in the Nursery: 15 July 1962 (37 mm.), 20 July 1962 (43 mm.), 9 Aug. 1962 (39 mm.), and 21 Sept. 1961 (42 mm.). These specimens are small compared with females from south India. No males have ever been seen by the author, either in Delhi or elsewhere in India.

DISTRIBUTION: This species is reportedly common throughout India (Evans 1932; Wynter-Blyth 1957). It is common in Lucknow (de Rhé-Philipe 1902), Lahore (de Rhé-Philipe 1917), Kutch (Nurse 1899), and Kathiawar (Mosse 1929), while it is fairly common in Amritsar (Sevastopulo 1948), uncommon in Jodhpur (MacPherson 1927), and very rare or extirpated in Karachi (Swinhoe 1887; Menesse 1950), where it has not been collected since 1886.

Precis lintingensis lintingensis (Osbeck)

The Yellow Pansy appears to be the least common *Precis* in Delhi. It is usually encountered in the Nursery, although a few specimens have been taken at Tughlakabad and on the Ridge. It has been collected from July III to Sept. IV, Nov. I to Jan. III, and on March IV and May IV. 26 specimens: 19 males (73%), 7 females.

Corbet (1945) has shown that *Papilio lintingensis* Osbeck, 1765, has priority over the well-known *Papilio hierta* of Fabricius, 1798. N. D. Riley has petitioned the International Commission on Zoological Nomenclature [*Bull. Zool. Nomencl.* **22**: 248-249, 1965; application No. Z. N. (S.) 1708] to use its plenary powers to suppress the name *lintingensis* so that *hierta* will once again be available for this species.

SIZE: ♂♂ 20 mm. (10 Nov. 1962, RCF) to 25 mm. (3 Nov. 1963, RLD). ♀♀ 24 mm. (several, July & Nov.) to 27 mm. (9 Aug. 1962, JPD).

VARIATION: The wet season form, which has a darker ground colour UNH than the dry season form, occurs from July III to Sept. IV.

DISTRIBUTION: This species is very common throughout India (Wynter-Blyth 1957), and has been recorded on all sides of Delhi.

Precis orithya swinhoei (Butler)

The Blue Pansy is the most common Delhi *Precis*. It occurs in all habitats throughout the year except in June and early July, for which there are no records. It is most abundant during and after the monsoon, especially in the Nursery. A tattered male and a fresh female were collected in copula on 3 March 1962, and a female was collected at light on 17 November 1961 (Donahue 1962b). 118 specimens: 64 males (54%), 54 females.

SIZE: ♂♂ 17 mm. (2 Dec. 1962, 3 Feb. 1963, RCF) to 25 mm. (3 Nov. 1962, RCF). ♀♀ 18 mm. (21 Feb. 1963, RCF) to 26 mm. (24 July and 8 Sept. 1961, JPD). The smallest specimens are as small as, or smaller than, the record " dwarf " reported by Crawford (1930), which had an " expanse " of 36 mm. (sex not stated).

VARIATION: The wet season form, with two prominent ocelli UNH, has been collected from July III to Oct. I. Traces of the ocelli reappear in specimens from March to May, reminiscent of the appearance of ocelli in April and May specimens of *Precis almana.*

DISTRIBUTION: The Blue Pansy occurs throughout India (Wynter-Blyth 1957), and has been recorded on all sides of Delhi.

Precis lemonias lemonias (Linnaeus)

Evans (1932) recognized three subspecies of the Lemon Pansy in the Indian subregion: *P. l. vaisya* Fruhstorfer, from Ceylon and south and central India; *P. l. persicaria* Fruhstorfer, from Kashmir to Kumaon; and *P. l. lemonias* (Linnaeus), from Sikkim to Burma. Fruhstorfer's (1912) original descriptions of the first two " subspecies " indicate that these taxa as he knew them occurred in widely-scattered localities, certainly not in keeping with the modern concept of a subspecies; *persicaria,* in fact, was described as a *form* with a peach-coloured underside. Because I have been unable to find any constant geographical variation in a large series of this species from throughout India, and because the characterizations of the subspecies in Evans (1932) are inadequate, I have chosen to refer to the entire Indian population of this variable species as *Precis lemonias lemonias* (Linnaeus). Since this species occurs east to the Philippines (Fruhstorfer 1912), there is a good possibility that, somewhere within its range, this species may have recognizable subspecies.

The Lemon Pansy occurs in all habitats, but is more frequently collected in the Nursery. It is most abundant during and after the monsoon, but single specimens may be encountered during the winter and dry season. It has been recorded from June IV to Jan. I, and Feb. IV to April II (the seven specimens collected in the latter period are all males). 82 specimens: 53 males (65%), 29 females.

Longstaff (1912) wrote that from 7-12 Nov. 1903 this species "... appeared to be rather fond of shade; they settled upon the ground in preference to flowers, and then were hard to see."

SIZE: ♂♂ 22 mm. (several, March II and III, June IV) to 27 mm. (29 Aug. 1961, JPD). ♀♀ 21.5 mm. (25 Dec. 1962, RCF) to 29 mm. (21 Sept. 1961, JPD).

VARIATION: The wet season form, which has a well-marked pattern with ocelli UNH, occurs from June IV to Oct. I. The dry season form has the pattern and ocelli reduced UNH and has a falcate apex on the forewing.

DISTRIBUTION: This species occurs in the Himalaya from Kashmir to Assam and Burma, in Ceylon and on the Deccan Plateau, and in Saurashtra (Wynter-Blyth 1957)—a range which circumvents Delhi. However, it is also common in Lucknow (de Rhé-Philipe 1902), Jodhpur and Mount Abu (MacPherson 1927), and Lahore (de Rhé-Philipe 1917). It has even been collected in Karachi (Swinhoe 1887), and elsewhere in Sind (Menesse 1950), where it is apparently very cyclic in its abundance.

Precis almana almana (Linnaeus)

The Peacock Pansy has been collected in the Nursery every month except February. It is most common during and after the monsoon, from mid-July through December. Only one specimen, a male, has been collected on the Ridge. 61 specimens: 43 males (70%), 18 females.

SIZE: ♂♂ 24 mm. (3 specimens, from March IV, May IV, and Dec. IV) to 28 mm. (25 Sept. 1961, JPD). ♀♀ 22 mm. (15 March 1964, RLD) to 29 mm. (31 July 1962, JPD).

VARIATION: The seasonal forms are well-marked. The DSF has the " dead-leaf " pattern on the underside, where the ocelli are absent UNH, the hindwing tornus is produced, and the forewing apex is falcate. The WSF has prominent ocelli UNH, a rounded tornus on the hindwing, and a rounded apex on the forewing. This is another of the Delhi butterflies in which the " wet season " form begins flying before the wet season begins. The WSF has been collected April II and May IV to Nov. II. The DSF flies from Sept. IV to March IV, with both forms occurring from Sept. IV to Nov. II.

DISTRIBUTION: The Peacock Pansy occurs throughout India (Wynter-Blyth 1957), and has been recorded on all sides of Delhi.

Vanessa cardui (Linnaeus)

Only two specimens of this cosmopolitan species have been collected in Delhi. I collected a male on 20 Jan. 1962, and RCF obtained a female on 23 March 1963. Both specimens came from the Nursery, and the forewing of both is 27 mm. long.

DISTRIBUTION: The Painted Lady occurs throughout India (Evans 1932; Wynter-Blyth 1957), and usually occurs during the fall and winter on the plains of northern India. It appears to be less common in the desert tracts west of Delhi. Presumably it " migrates " to Delhi from the Himalaya, so it may be more abundant in some years than in others.

Argynnis hyperbius hyperbius (Johannsen)

Only two specimens of the Indian Fritillary have been collected in Delhi: I collected a perfect male (36 mm.) as it visited wildflowers in the Nursery on 13 April 1962, and RCF collected a second male (34 mm.) on the Ridge, 27 March 1964.

DISTRIBUTION: The appearance of this Himalayan species in Delhi came as a surprise. It is resident on Mount Abu (Evans 1932; MacPherson 1927; Wynter-Blyth 1957) and in the Himalaya (Evans 1932; Wynter-Blyth 1957), where the larva feeds on violets. Most authors have assumed that this butterfly occasionally strays from the hills onto the plains, but de Rhé-Philipe (1902) collected specimens from late September to March and found the larvae feeding on *Lobelia* and potted violets in Lucknow, while Longstaff (1912) collected a female there 24-25 Nov. 1903. Robson (1893) found and reared the larvae on cultivated pansies (*Viola* sp.) in Bankipore, Bihar (near Patna), and Sanders (1955) reared adults from larvae he found on pansies in his garden in Kanpur, U.P.

Other records from the plains include specimens taken during the winter in Agra, U.P. (de Niceville 1886) and a single male taken and another seen in Feb. 1929 at Kundla, west of Bhavnagar, Gujarat by Mosse (1929), who has also seen several females during the monsoon at Sadra, 30 miles north of Ahmedabad, Gujarat. Swinhoe (quoted in Moore 1899-1900) reportedly took several specimens in Bombay in 1877, but it has apparently not been seen there since.

A careful search may show the species to be established in Delhi, since the larvae could feed on the pansies which are cultivated there during the winter.

Phalanta phalantha phalantha (Drury)

The Common Leopard is never abundant in Delhi. The females occur on the Ridge and in the Nursery with approximately equal frequency, but only one of the males has been collected in the Nursery. It flies during and after the monsoon, from July II to Aug. IV, and Nov. III and IV. 28 specimens: 15 males (54%), 13 females.

SIZE: ♂♂ 19 mm. (18 Nov. 1962, RCF) to 28 mm. (9 Aug. 1962, JPD; 18 Nov. 1962, RCF). ♀♀ 25 mm. (28 Aug. 1961, JPD) to 31 mm. (28 July 1961; 5 Aug. 1962, JPD).

VARIATION: The females are generally larger and more heavily marked than the males.

DISTRIBUTION: This species is common throughout India (Wynter-Blyth 1957), and has been recorded on all sides of Delhi. See Fox (1964) for the latest treatment of the genus, formerly known as *Atella.*

Ergolis merione tapestrina Moore

The only record of the Common Castor from Delhi is a specimen in the I.A.R.I. collection, caught by Dr. M. G. Ramdas Menon.

DISTRIBUTION: This subspecies occurs from the Central Provinces to Orissa, and Kashmir to Kumaon (Evans 1927). The only other record near Delhi is from Lucknow, where de Rhé-Philipe (1902) saw two specimens in October.

The adults should be looked for near castor plants (*Tragia* spp.), the larval foodplant, some of which grow in the Nursery and probably elsewhere in Delhi.

DANAIDAE

Danaus chrysippus chrysippus (Linnaeus)

The Plain Tiger is one of the most common and conspicuous butterflies in Delhi, occurring throughout the year in all habitats, although it is uncommon in January, February, May, and June. 317 specimens: 199 males (63%), 118 females.

Longstaff (1912) found this species common in Delhi, 7-12 Nov. 1903.

Nine copulating pairs have been collected, from March IV to Nov. I (Table 4). With one major exception (1 Nov. 1962), the copulating males are almost the same size as, or slightly larger than, the females.

TABLE 4

RECORDS OF COPULATING PAIRS OF *Danaus chrysippus*

Date	Forewing Length (mm.)		Collector
	♂	♀	
24 March 1963	35	30	RLD
28 July 1961	33	34	JPD
11 Aug. 1962	35	33	RLD
28 Aug. 1961	40	38	JPD
21 Sept. 1963	37	34	RCF
25 Sept. 1961	37	37	JPD
1 Nov. 1962	30	40	RLD
3 Nov. 1962	39	36	RCF
4 Nov. 1961	42	35	JPD

A photograph taken of a copulating pair in November 1961 clearly shows that the male is doing the transporting, while the female is passive. To the contrary, Pronin (1964) observed that the female of *D. plexippus* was the transporter during the flight of a copulating pair in California.

Danaus chrysippus has been attracted to lights in New Delhi (Donahue 1962*b*).

SIZE: ♂♂ 26 mm. (9 May 1962, JPD) to 42 mm. (13 April 1962, JPD). ♀♀ 25 mm. (31 March 1963, RCF) to 40 mm. (several). " Dwarf " specimens are relatively frequent. Both the male and female dwarfs indicated above are smaller than the dwarf reported by Crawford (1930), which had an " expanse " of 58 mm. A dwarf from Lucknow has been reported with an " expanse " of " not more than 2.1 inches " [=53 mm.] (de Rhé-Philipe 1902).

VARIATION: Of the two most distinctive forms of this species, " dorippus " (Klug) and " alcippoides " Moore, only the latter has been collected in Delhi—a fresh male collected in the Nursery on 23 March 1963 (41 mm.) by RCF. Elsewhere in the Indian subregion the " alcippoides " form has been recorded from Lucknow (de Rhé-Philipe 1902); Lahore (de Rhé-Philipe 1917); Bhavnagar, Kathiawar (Mosse 1929); Karachi, Pakistan (Swinhoe 1887), and elsewhere in Sind (Menesse 1950); Calcutta (Percy-Lancaster 1949); and Campbellpore, West Pakistan (Butler 1886). In addition to some of the localities above, Moore (1890-1892) records its occurrence in Nepal; Nurpur, W. Pakistan; Deesa, Gujarat; Neemuch, Panghur (near Neemuch), and Mhow, Madhya Pradesh. Quoting de Nicéville (*Journ. Asiatic Soc. Bengal*, 1885, p. 40), Moore also adds Faizabad, U.P.; Bholahat, Malda District, West Bengal; and Khurda, Orissa, to the list of localities where the " alcippoides " form has been collected.

The more frequent " dorippus " form has been recorded from a number of arid localities in India (Donahue 1962*a*), and it is probably only a matter of time before a specimen is collected in Delhi.

DISTRIBUTION: The Plain Tiger is very common throughout India (Talbot 1947; Wynter-Blyth 1957), and the arid plains of north-western India are no exception.

Danaus genutia (Cramer)

Although Talbot (1947) refers to this species as *D. plexippus plexippus* (Linnaeus), Cramer's name is in general use in the Orient, and it is employed here to differentiate this species from the American species which Western taxonomists call *D. plexippus*. This butterfly has only been recorded during the monsoon season, July II to Sept. II, from both the Nursery and the Ridge. A copulating pair was collected on 5 August 1962 (JPD). 25 specimens: 14 males (56%), 11 females.

SIZE: ♂♂ 37 mm. (5 Aug. 1962, JPD) to 46 mm. (5 Aug. 1962, 26 Aug. 1961, JPD). ♀♀ 36 mm. (14 Aug. 1962, JPD) to 46 mm. (21 July 1962, JPD).

DISTRIBUTION: The Common Tiger occurs throughout India (Talbot 1947; Wynter-Blyth 1957). It has been recorded during the monsoon season from other localities on all sides of Delhi.

Danaus limniace leopardus (Butler)

The Blue Tiger is rare in Delhi—only two males have been collected, both from the Nursery: 26 July 1962 (41 mm.) and 28 Aug. 1961 (36 mm.).

DISTRIBUTION: This species is common in peninsular India, although it also occurs in the Himalaya (Talbot 1947). It occurs during the monsoon on all sides of Delhi.

Euploea core core (Cramer)

The Common Indian Crow is a very local and uncommon species that has only been found in a particular shaded, damp area in the Nursery, where *Leptosia nina* and *Mycalesis perseus* also occur. It has only been collected from July II to Nov. I (no October specimens). Longstaff (1912) found it "... common in shady places under mango trees, but was rarely seen at flowers," 7-12 Nov. 1903. 12 specimens: 3 males (25%), 9 females—one of the few Delhi butterflies whose females are more frequently collected than the males.

SIZE: ♂♂ 41 mm. (28 July & 29 Aug. 1961, JPD) to 45 mm. (3 Nov. 1963, RLD). ♀♀ 41 mm. (21 July 1962, JPD) to 47 mm. (19 July 1961, JPD).

DISTRIBUTION: This species occurs throughout India, where it is generally common (Talbot 1947; Wynter-Blyth 1957), although it apparently does not occur as far west as Sind (Menesse 1950).

SATYRIDAE

Mycalesis perseus tabitha (Fabricius)

Like *Euploea core*, the Common Bushbrown has only been found in a small, damp, shady area of the Nursery, where it flies from July III to Nov. III. Although the valva resembles that found in some populations of *M. mineus* figured by Evans (1920), all other characters of the facies listed by Talbot (1947) point to this species. 30 specimens: 18 males (60%), 12 females.

SIZE: ♂♂ 18.5 mm. (17 Nov. 1962, RCF) to 21 mm. (several). ♀♀ 21 mm. (2 specimens, 25 Sept. 1961, JPD) to 25 mm. (2 specimens, 4 Nov. 1961, JPD).

VARIATION: As in the other two Delhi satyrids, the seasonal forms are well-marked. The WSF, with prominent ocelli UNH, occurs from July III to Oct. I, while the DSF, with greatly reduced ocelli UNH, has been collected from Nov. I to Nov. III. Only five of the 30 specimens are of the dry season form.

DISTRIBUTION: Talbot (1947) records this subspecies from Ceylon north to the U.P. It has been reported from Lucknow (de Rhé-Philipe 1902) and Fatehgarh (Peile 1911), but there appear to be no other records west of Delhi, indicating that Delhi is near the western edge of the range of this species. The similar *M. mineus polydecta* (Cramer) apparently does not occur as far north or west as Delhi.

Ypthima inica Hewitson

Despite the status of " not rare " given the Lesser Threering by Talbot (1947) and Wynter-Blyth (1957), it is locally very common in Delhi. This little butterfly is virtually restricted to a wet grassy lowland area on the north side of the Nursery (plate I, 2), where it has been found from July IV to April II, and on May IV. A few stray specimens have also been collected on the Ridge, at Tughlakabad (29 Sept. 1961, JPD), and at Okhla (1 Dec. 1962, RLD). The species is most common during the monsoon season (59 specimens have been collected Aug. IV, of which 76% were males). Two copulating pairs were collected on 21 Sept. 1961 (JPD). 204 specimens: 137 males (67%), 67 females.

SIZE: Both sexes vary from 14 mm. to 18 mm., although dry season specimens are usually somewhat smaller than those from the wet season.

VARIATION: The seasonal forms are well-marked, but have an unusual temporal distribution. The dry season form " inica " Hewitson, with the ocelli UNH represented by mere dots, flies from Oct. IV to April II. But the ocellated wet season form " ariaspa " Moore has also been collected in April II, again in May IV, and during the monsoon from July IV to Nov. IV. The appearance of the " wet season " form in two of the hottest, driest months of the year, similar to the situation in several other species noted earlier, is an unexplained phenomenon that has apparently escaped the notice of other authors.

DISTRIBUTION: The Lesser Threering has been recorded from the Punjab to Bengal by Talbot (1947), while Swinhoe (1886) has recorded it in Mhow and Depalpur, Madhya Pradesh. de Rhé-Philipe (1917) has recorded two specimens from Lahore, and Sevastopulo (1948) says it is common in Amritsar, Punjab, but no other records from west of Delhi have been found.

Neither the widespread *Y. asterope mahratta* Moore nor *Y. ceylonica* Hewitson have been found in Delhi, even though the genitalia of all Delhi males were examined and compared with representatives of those species in the MSU collection, and with the figures in Cantlie & Norman (1959). *Y. ceylonica hubneri* Kirby has been recorded from Lucknow (de Rhé-Philipe 1902), while *Y. asterope mahratta* has been collected in Jodhpur and on Mount Abu (MacPherson 1927), Kathiawar (Mosse 1929), and Karachi (Swinhoe 1887). I have also collected *Y. mahratta* in Sumerpur, Rajasthan, 320 miles southwest of Delhi (5 Oct. 1961).

Either of these two species may be found in Delhi, but intensive collecting has so far failed to yield a specimen.

Melanitis leda ismene (Cramer)

This crepuscular species is best collected in the evening, although one may find specimens during the day by beating the bushes in the Nursery. It has also been collected at light (Donahue 1962*b*). Outside the Nursery it has only been taken at Tughlakabad (29 Sept. 1961, JPD), though it probably occurs in other favourable habitats in the State. It flies only during and after the monsoon, from July III to December III. 35 specimens: 13 males (37%), 22 females—another of the few Delhi species in which the female is collected more often than the male.

SIZE: The forewing of both males and females varies from 32 mm. to 37 mm. in length.

VARIATION: The seasonal forms are very different from each other in the markings on the underside of the hindwing: the WSF "determinata" Butler, which flies from July III to Oct. I, has conspicuous ocelli UNH, while the DSF "ismene" (Cramer), which flies from Oct. I to Dec. III, has no ocelli. Both forms have been collected together in the first week of October.

DISTRIBUTION: The Common Evening Brown is found throughout India, although it becomes less common in the desert areas of western India (Talbot 1947). It has apparently not been recorded in Sind since 1886, when Swinhoe (1887) caught two specimens in Karachi.

HYPOTHETICAL LIST

In addition to the 77 species recorded from Delhi in this paper, there are 32 other species which have been recorded from neighbouring localities that may yet be found in Delhi. The authorities for the records are the same as those which have been cited in the text, unless another source is cited. A question mark indicates doubt on my part concerning the proper identification of the species.

HESPERIIDAE

Sarangesa dasahara (Moore) ssp.: Lucknow; Mount Abu (Evans 1949; MacPherson 1927).

Udaspes folus (Cramer): Lucknow, Mount Abu, Kathiawar.

Oriens gola pseudolus (Mabille)?: Lucknow? (de Rhé-Philipe 1905); the westernmost record in the B.M. is the Nepal Terai (Evans 1949).

Telicota ancilla bambusae (Moore): Amritsar? (Sevastopulo 1948); Lucknow (de Rhé-Philipe 1902; Evans 1910). The distribution given by Evans (1949) indicates that this species may occur as far west as Delhi.

Borbo bevani (Moore)?: Lahore; Karachi (Swinhoe 1887), possibly confused with *B. cinnara*. Nearest record in B.M. is "Central India" and Kumaon (Evans 1949).

PAPILIONIDAE

Polydorus hector (Linnaeus): Jodhpur.

Papilio clytia clytia Linnaeus, form "dissimilis" Linnaeus: Lucknow; Fatehgarh (Peile 1911).

PIERIDAE

Appias lyncida (Cramer) ssp.: Lucknow (reported as *A. hippoides* Moore, a synonym); Fatehgarh? (Peile 1911).

Pieris brassicae nepalensis Doubleday: Lucknow, Amritsar (Sanders 1930); Lahore.

Colotis phisadia protractus (Butler): Lahore?; Jodhpur; Kutch, Sind; Kaira District, Gujarat; Lyallpore, West Pakistan (Sevastopulo 1948). In flight it will resemble *C. calais*.

Colotis danae dulcis (Butler): Jodhpur; Kutch; Sind; Kathiawar; Gujarat (MSU collection).

Valeria valeria anais (Lesson) (formerly *V. v. hippia*): Lucknow; Fatehgarh (Peile 1911).

RIODINIDAE

Abisara echerius (Stoll) ssp.; Fatehgarh.

LYCAENIDAE

Everes lacturnus (Godart) ssp.: Kanpur, U.P. (Sanders 1955).

Jamides bochus bochus (Cramer): Jodhpur; Kaira Dist.; possibly a specimen in I.A.R.I. collection, obtained in Delhi, April 1958, by M. G. Ramdas Menon. Specimen could not be examined by author. West Pakistan? (Cantlie 1962, but Menesse 1950, did not record it).

Iraota timoleon (Stoll) ssp.: Lucknow.

Apharitis acamas hypargyrus (Butler): Kutch; Sind; Kathiawar; Punjab (Cantlie 1962). A stray specimen may occur as far east as Delhi.

Spindasis elima elima (Moore): Lucknow; Sind.

Tajuria jehana Moore: Lucknow.

Tajuria cippus cippus (Fabricius): Lucknow; "Pakistan - India Burma - Common." (Cantlie 1962).

Virachola isocrates (Fabricius): Lucknow; Mount Abu; Kutch; Kathiawar; Karachi; Kaira District. The larva feeds on fruits of pomegranate and guava, and the adults should be looked for in groves of these plants.

Rapala varuna orseis (Hewitson): Lucknow. The larva feeds on the flowers of *Zizyphus xylopyrus.*

Rapala manea schistacea (Moore): Bareilly, U.P. (de Rhé-Philipe 1902). Larvae have been reared on flowers of the Rangoon Creeper (*Quisqualis indica*) and *Acacia caesia.*

NYMPHALIDAE

Euthalia garuda (Moore) ssp.: Lucknow; Lahore; Amritsar. The larva has usually been reared on mango and cashew.

Neptis hylas varmona Moore: Lucknow. A widespread species that may stray into Delhi.

Precis atlites (Linnaeus): Lucknow.

Precis iphita (Cramer) ssp.: Lucknow; Kanpur, U.P. (Sanders 1955).

Cirrochroa tyche mithila Moore: Lucknow; Fatehgarh—remarkable records, since this species is not normally considered to occur west of Sikkim.

ACRAEIDAE

Acraea violae (Fabricius): Lucknow, where it is abundant some years and rare in others (de Rhé-Philipe 1902); Fatehgarh, probably the northwestern-most record of this southern species.

SATYRIDAE

Ypthima asterope mahratta Moore may be found in Delhi. See the comments under *Y. inica.*

Orsotrioena medus (Fabricius) ssp.: Lucknow.

Melanitis phedima (Stoll) ssp.: Lucknow.

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Studies in Taxonomy and Ecology of *Bursera delpechiana* Poiss. ex Engl. in India

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(*With a plate*)

Bursera delpechiana Poiss. ex Engl. is an economic plant, the source of ' oil of linaloe ' of commerce. The oil is used as a fixative for high grade perfumery and cosmetic products. There has been a long controversy over sexuality in the species. It has been found to be dioecious by the authors. Complete taxonomic details of the species have been worked out.

The tree grows well under Indian conditions and shows much better growth than in its original home in Mexico under forestry conditions. Edaphic and climatic conditions favouring the luxuriant growth of the species in India have been studied and are listed in the paper to encourage its commercial plantation.

INTRODUCTION

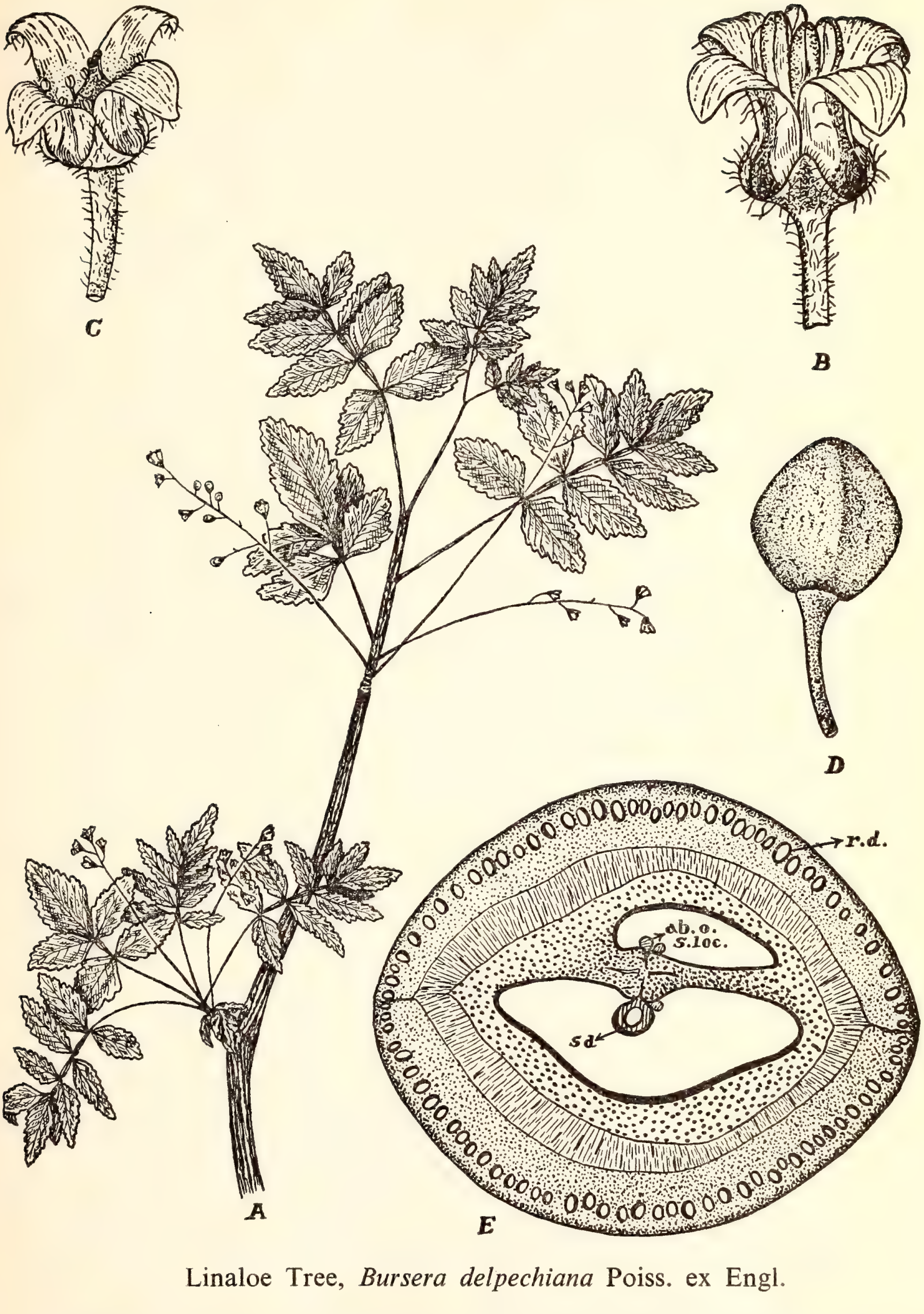
' Oil of linaloe ' is derived from the wood and fruits of *Bursera delpechiana* Poiss. ex Engl. and allied species [*B. alöexylon* (Schiede.) Engl., and *B. glabrifolia* (H.B.K.)], all growing wild in Mexico. The entire world supply of the oil comes from Mexico. The oil is a rich source of linalol and linalyl acetate and is highly priced for its aroma. It is extensively used as a fixative for high grade perfumery and cosmetic products. Indian oil of linaloe, on the contrary, is derived entirely from the fruits of *B. delpechiana* Poiss. ex Engl., and possesses a superior staying power in comparison with the oil produced in Mexico (Sastry 1945). The total production averages to about 6,000 kg. of oil and the entire quantity is consumed in the country. In view of the exceedingly fine odour, the Indian oil of linaloe has good prospects for export. It is therefore desirable that *Bursera* plantations be raised on a substantially large scale in suitable localities in the country.

Bursera delpechiana Poiss. ex Engl. was introduced into this country by two enterprising Scotsmen—P. J. Anderson and G. N. Humphries, from seeds brought by them from Mexico in 1912 (Burton 1951). After trials at a number of places in Mysore, they finally raised a commercial plantation at Tatgunni, about 20 km. from Bangalore City. The Tatgunni Estate has a monopoly in production of this oil and about 125 hectares of its area is under regular plantation. Interest in the species has recently revived, mainly due to the efforts of Essential Oils Research Committee and its successor the Central Indian Medicinal Plants Organisation of the Council of Scientific & Industrial Research. A plantation of over 500 hectares has been raised by Mysore Forest Department in Gattipura, Nallal and Jharakbunde forest blocks of Bangalore District. Experimental cultivation has also been undertaken at more than a dozen places at widely separated areas in south India and the results are encouraging.

Despite the economic importance of the plant and its products, information on systematics and ecology of the species has so far been incomplete. In fact, the latest description of the species in botanical literature is in De Candolle's MONOGRAPHIAE PHANEROGAMARUM of 1883. Publications from India for the last three decades have variously described the sexuality in the species, and this in turn has caused a set-back in determining the number and location of the male trees in a plantation. Sastry (1945) mentions that " some trees in Tatgunni Estate put on flowers only, yielding no berries ". He argues in a later work (1952), that " this led to the belief that there are male and female linaloe trees. But it has been authoritatively stated that this is not so. The flowers possess normal reproductive organs of both sexes i.e. bisexual". Hussain (1958), on the contrary, describes it as dioecious. More recently Rangegowda & Ramaswamy (1965) stated that " the dioecious nature of the species has not been confirmed ". In view of these uncertainties, detailed studies have been undertaken by the authors covering various aspects of cultivation in the country which will be published later. The present communication, however, covers taxonomy and ecology of the species. The material for the study was collected by the senior author from commercial plantations in the vicinity of Bangalore City during May 1965, and a thorough examination of the species was made in the field.

TAXONOMY

Deciduous shrubs or small trees attaining 6 m. height and 1 m. girth at age of 20 years. *Tap root* not seen, all the plants examined being raised from shoot-cuttings. *Lateral roots* six or more in number, first travelling obliquely 1 to 2 m. in depth then turning upwards and ultimately traversing more or less parallel to the ground to a distance of about 4-5 m. in old trees; texture brittle, light in weight and up to 2 cm. thick in trees of over 35 years age; *epidermis* greyish brown, paper thin, peeling off in flakes in older roots; *hypodermis* dull-brown, 0.2 to 0.3 cm. in thickness; *wood* light-yellow. *Roots* have characteristic linaloe odour. *Trunk* short, branched freely above to form a loose oval dome. *Old branches* mostly with distant, alternate, short, conical arrested branchlets, smooth, longitudinally ridged when dry; *bark* deep-brown, papery, easily peeled off exposing inner green layer, often transversely



Linaloe Tree, *Bursera delpechiana* Poiss. ex Engl.

A. Flowering twig ×½; B. Staminate flower ×9; C. Pistillate flower (Staminodes visible) ×9; D. Fruit ×1; E. T. S. fruit (diagrammatic) r.d.—resiniferous ducts, sd.—seed, ab.o.—abortive ovule, s.loc.—suppressed loculi.

ruptured at length. *New twigs* glabrescent, always terminal on old branches as well as arrested branchlets. *Leaves* (3-) 7-9-foliolate, up to 15 cm. long, distantly alternate on new shoots or pseudoterminally clustered and comparatively shorter on arrested branchlets, developing from the axil of apical crown of stipular caducous scales. *Scales* chaffy, light brown, 0.6-1.2×0.4-0.6 cm., variable in size and shape in the same crown, broadly-ovate to ovate-oblong, abruptly deflexed from above the constricted base, thickened along the middle, obtuse to almost round and hooded at the apex with a prominent apiculum just below the tip, densely glandular on both surfaces. Leaf-rachis sparsely pilose with mixed glandular hairs, between the pairs of leaflets broadly winged, wings usually broad above, narrowed gradually downwards. *Petiole* slender, up to 4 cm. long, deeply channelled. *Leaflets* up to 5.5×2.2 cm., ovate or rhomboid-ovate, sometimes oblique, minutely pubescent above, villous beneath, densely so on veins, acute at apex, round or abruptly short-attenuate at base, sub-sessile to short-petiolate, serrate-crenate in the upper region, entire below, the terminal leaflet usually larger than the lateral ones and conspicuously long-attenuated at the base or often at the apex also.

Inflorescence a paniculate cyme with pubescent axes, up to 10 cm. long, pseudo-terminal as well as axillary from the leaves on new shoots or from the leaf-scar of the fallen leaves, those borne on the arrested branchlets distinctly shorter. *Flowers* dioecious, tetramerous, bracts subtending the branches linear-lanceolate, 0.2-0.4 cm. long, those subtending the flowers minute, subulate, hardly exceeding 0.15 cm., both glandular-hairy, densely on inner surface. *Pedicel* of the terminal flower up to 0.8 cm. long, of the laterals up to 0.4 cm., pilose with mixed glandular hairs, densely so towards the top. *Pistillate flowers: Sepals* green, deltoid, thick, below 0.1 cm. in length, glandular-hairy, inserted below the disc. *Petals* creamy, about 0.3×1.2 cm., oblong, acute, half deflexed, densely villous with mixed glandular hairs at the back, glabrous inside, acute with an obscurely hooded tip, inconspicuously thickened along the margins (microscopically papillose). *Staminodes* 8, apparently normal but anthers without sporogenous tissue, in two whorls, obdiplostaminous, about 0.15 cm. long; filaments nearly as long as the anthers, much dilated at base, gradually narrowed upwards, inserted below the disc. *Disc* annular, crenately 8-lobed, about 0.15 cm. in diameter. *Ovary* conical, laterally compressed, glabrous, attenuated to a short 2-armed style; loculi 2 with 2 ovules in each. Stigmas more or less globular, slightly lobed. *Staminate flowers: Sepals* as in female. *Petals* often slightly longer than those of the female, otherwise similar. *Stamens* 8, 0.25-0.3 cm. long, anthers dorsifixed, adnate near the base. Filaments much dilated at base, gradually narrowed upwards, as long as or slightly longer than anthers. *Pollen grains* radio-symmetrical, 3-zonipororate, exine thick excepting at pores. *Disc* slightly narrower than of the female. *Pistillode* minute.

Fruit drupaceous, one-seeded, one of the loculi invariably suppressed forming one pyrene (all ovules except one abortive), ovoid, about 1 cm. diameter, biconvex, with indistinct four facets in the upper half, green, tinged red towards sunny face. Chromosome number $n=12$ (Srivastava *et al* 1965).

DISCUSSION

1. *Staminodes* in female flowers on a casual look appear quite normal. A close examination of sufficient material gathered from different commercial plantations reveals that these stamens are not only conspicuously shorter than the fertile ones in male flowers but are invariably without any sporogenous tissue. This has probably misled some of the earlier workers to account these flowers as bisexual. The flowers thus are unisexual and dioecious.

2. In one of the trees of 1958 Gattipura Forest Plantations, it has been observed that a male tree bears occasional fruits of normal size. These berries were invariably present only on inflorescence developing from axil of lower fallen leaves of the old branches. Although no female or bisexual flowers are available, it is quite probable that pistillode in such flowers becomes functional producing these fruits.

3. Lawrence (1951) has pointed out that the fruit in *Burseraceae* is morphologically a berry, stating that " throughout the literature the baccate fruit of the family is designated a drupe or as drupaceous with 1-5 stones. There seems no morphological basis for treating it other than a berry that on occasion may be one-seeded by abortion." However, even in recent standard works (Leenhouts 1956) the fruit has been called a drupe and the same has been adopted by the authors.

4. *Stem-bark* has marginal resiniferous ducts bordered on the outside by a distinct, more or less interrupted, sinuous sclerenchymatous tissue. The pericarp of the fruit also possesses similar resiniferous ducts. The sclerenchymatous tissue does not allow the oil contained in the ducts to escape, but when injured transversely, as is practised in Mexico, the formation of oil is enhanced and the rate of exudation increases.

ECOLOGY

No information is available in literature, about the soil and climatic conditions prevailing in areas which this species inhabits, excepting that it grows on shallow soils in arid rocky regions of Mexico. The tree grows very well in its new home and in fact shows comparatively much better growth in India than in its original home. Krishna & Badhwar (1948) record that " The 25-year-old trees of Tatgunni Estate resemble in appearance and girth those of 60 years of age and upwards as represented by sections of the trees brought from Mexico". A study was therefore undertaken to list ecological factors favouring the growth of the plant in India so as to encourage extension of its cultivation in the country.

Bursera delpechiana Poiss. ex Engl. is a hardy, more or less xerophytic species that makes little demand on land. Its deciduous nature and its shooting of vegetative growth and flowering simultaneously during a limited growing period of seven to eight months (April-November) happily synchronizes with the climatic vagaries of an arid tropical region. The plant flourishes well in sunny localities between 800 and 1200 m. above sea-level. It grows well on lateritic to red soils where the parent underlying rock is granitic-gneiss of Archean formation. The texture varies from loam to sandy-loam invariably mixed with gravel and pebbles, shallow to as deep as 10 m. (Nallal plantation) and is dominantly dry. Good drainage is essential. In regions of undulating topography, trenches at a distance of 10 m. are made along the contour to conserve moisture for the plantation by reducing run-away of rain water. The plant has been observed to come up normally in partially eroded areas but the growth in deep, average fertile soil is visibly better. A comparative study of yield of fruits under different soil types and fertility however, deserves experimental work.

The plant favours hot dry summers, the average maximum and minimum temperature of the year is 35°C and 18°C and the total annual rainfall usually measures between 450 mm. and 650 mm. distributed throughout the growing period but bulk of the precipitation however, is received from north-east monsoon in September-October. Humidity is low for most of the year excepting the monsoon months. Blossom rains during April-May increase incidence of flowering and fruiting. The plant is sensitive to frost and water-logged conditions.

The natural vegetation of the area is dry scrub having few tree species mostly *Acacia* and *Albizia*. *Acacia leucophlaea* Willd., *A. suma* Kurz, *A. concinna* DC., *Albizia odoratissima* (Roxb.) Benth., and *Santalum album* Linn., have been prominently recorded. *Casuarina equisetifolia* Forst. is raised commercially on poor lands in the area as a fuel crop. The ground cover mostly comprises *Dodonaea viscosa* Linn., *Cassia auriculata* Linn., *Carissa spinarum* A.DC., *Lantana camara* Linn., *Erythroxylon monogynum* Roxb., *Calotropis gigantea* Br., *Asparagus racemosus* Willd., *Argemone mexicana* Linn., and a large number of annual weeds, grasses and sedges.

Vast stretches of land having the above stated edaphic and climatic conditions are available in Mysore, Madras, Maharashtra, Andhra

Pradesh, and Madhya Pradesh where the plant could be raised. The Central Indian Medicinal Plants Organisation have recently introduced this species in certain selected localities in northern India and the results are being watched with interest. If these efforts succeed, it would open entirely new areas for raising commercial plantations of the species.

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On some aspects of the Biology of *Coilia dussumieri* (Cuv. and Val.)[1]

BY

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(*With six figures*)

The smaller sized individuals of *C. dussumieri* apparently inhabit shallower and inshore waters, while the larger fish live in deeper and offshore waters. The inshore waters are fished intensively during the monsoons, resulting in a preponderance of fish below a length of 110 mm. in the catch.

Due to the protracted spawning period of the fish, there is no progression of modes in the monthly length frequency distributions.

The size at first maturity has been estimated at 131-140 mm.

The sex ratio of 53.41 males: 46.59 females deviates significantly from the 50:50 ratio. Males outnumber females in higher length groups, probably because the females migrate to offshore grounds at a smaller size.

The spawning season probably extends from September to March.

The fish has a protracted spawning period and spawns more than once in each spawning season.

The total number of possible spawnings has been estimated at three, from the ratio of the number of ova in the last batch to the number of remaining maturing eggs.

The ponderal index curve changes slope at 130 mm., considered to be the size at first maturity. There are no regular seasonal variations in the ponderal index.

Fecundity is estimated at 1200 to 4200 eggs per spawning.

INTRODUCTION

Coilia dussumieri is common in the estuaries of Bombay and Orissa. This fish, locally known as *Mandeli*, is very important commercially and is landed in appreciable quantities throughout the year at Bombay. It is fished, along with a variety of other fishes and prawns, in a type of bag-net called the *dol.*

Earlier accounts of the species include skeletal system (Joshi & Bal 1953 *a* and *b*), eggs and early development (Delsman 1932), post-larval stages (Jones & Menon 1952), seasonal changes in the gonad condition

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(Palekar & Karandikar 1953), food and feeding habits, sex composition and length-weight relationship (Bal & Joshi 1956) and food and feeding habits at different growth stages (Bapat & Bal 1950). Verghese (1961) has given an account of the biology of *Coilia borneensis.*

Our knowledge of the reproductive biology of the fish is meagre. Palekar & Karandikar (1953) could only conclude that *C. dussumieri* is an offshore breeder with a protracted spawning period. This paper deals for the first time with the length-frequency distribution, size at first maturity, ponderal index, and fecundity of *C. dussumieri.* It also attempts to define more precisely the breeding season, and the number of spawnings per season, and records the occurrence of spent specimens.

METHODS

Samples were collected once a week over a period of one year from October 1963 to September 1964 from commercial landings of the *dol* fishery at Sassoon Docks, Bombay. Altogether 1,567 specimens were examined for the study of length-frequency distribution. Of these 493 male, 430 female, and 230 juvenile specimens were examined to ascertain the state of development of the gonads. Ova diameter frequencies were determined for 125 representative ovaries by Clark's method (Clark 1934). 21 ovaries were used to estimate fecundity by counting directly the number of ova in the last mode from a known fraction of a previously weighed ovary.

LENGTH FREQUENCY DISTRIBUTION

The data pertaining to the length frequency distribution of each month are presented in Figure 1 after grouping at intervals of 5 mm.

Monthly length frequency polygons are well marked in Figure 1 and seem to be of two different types. Those of the seven months from October to April show a very similar pattern. During these months a large proportion of individuals fall in the size range 151 to 165 mm. (modal group *a*). The remaining fish are distributed over a wide range, extending from 61 mm. upwards, forming a number of small modes. The distribution in the month of May is similar to that found during the period October-April, except that no fish smaller than 120 mm. was present. The pattern of distribution is different during the four months of monsoon viz. June to September. In these months a modal group is present in the size range 151 to 155 mm. (modal group *a*), but is much less prominent. On the other hand, the proportion of the smaller sized individuals is greater. The size groups 131-135 mm., 106-110 mm. and 126-130 mm. form distinct modes (modal groups *b*), in the months of June, August and September respectively.

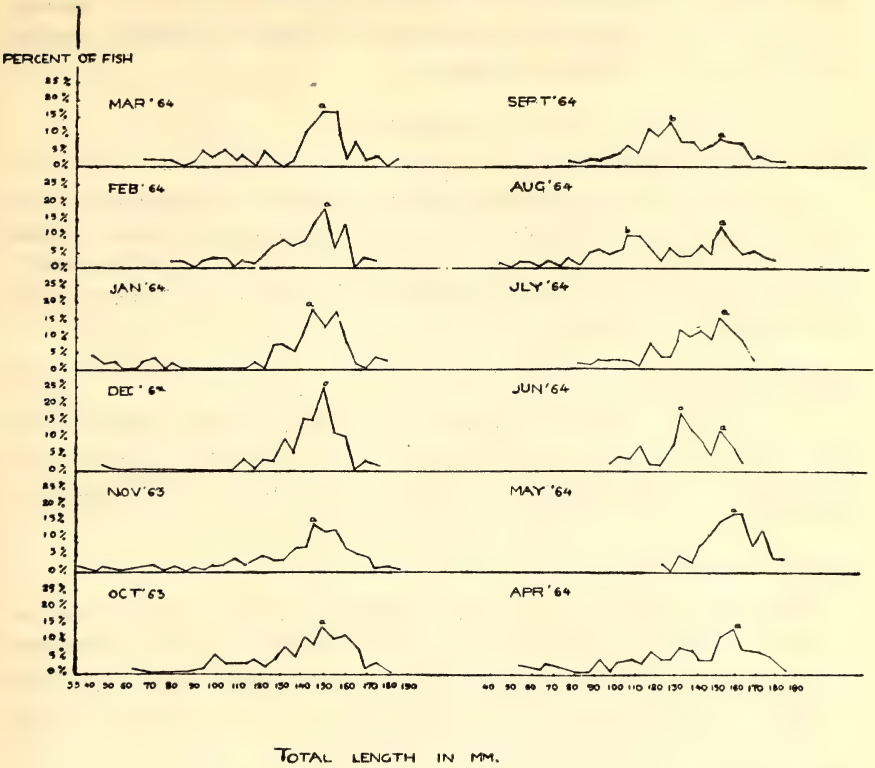

Fig. 1. Length frequency distribution of *Coilia dussumieri*.

Neither the fishing gear, nor the fishermen exert any selective action with respect to the size of the fish caught, as the *dol* net collects even very small fishes including the shrimps *Acetes* and the fishermen retain the entire catch.

Enquiries with local fishermen revealed that the operation of *dol* nets is concentrated in shallow and more inshore waters during the monsoon months. Apparently, *Coilia dussumieri* are distributed with the smaller specimens occurring in shallower waters, closer to the coast, and the larger specimens occurring in deeper waters farther off the coast, as in the case of the classical example of the distribution of Plaice *Pleuronectes platessa* (Graham 1956). As the shallower and more inshore waters are fished intensively only during the monsoon, the smaller sized fish predominate in the catches during these months.

No progression of modes is apparent in the length frequency distribution from month to month. The principal mode falls in the range 151-165 mm. from October to May. A distinct mode occurs in this range during the June-September period as well. That the length frequency distribution remains without much progress from month to month may be due to the prolonged spawning period of the fish which extends from September to March (see page 63).

BREEDING

(a) *Stages of Maturity*

The female *Coilia dussumieri* was distinguished as belonging to five stages of maturity on the basis of the stage of development of intraovarian eggs. These growth stages were designated as (i) Immature, (ii) Maturing, (iii) Ripening, (iv) Ripe, and (v) Spent (Qasim 1957 *a* and *b*, Qayyum & Qasim 1964 *a*, *b* and *c*).

Stage I. *Immature*

Ovaries small, translucent, and elongated; ranging from 10 mm. to 22.5 mm. in length, and containing a large number of small, fully transparent ova without yolk, diameter varying from 0.07472 mm. to 0.1868 mm.

Stage II. *Maturing*

Ovaries granular and somewhat enlarged, ranging from 13 mm. to 36 mm. in length. In addition to the stock of fully transparent, immature ova, a number of maturing ova are also present. These are whitish and opaque, and well supplied with yolk. Maturing ova grow up to 0.7472 mm. in diameter, the average size being 0.5604 mm.

Stage III. *Ripening*

Ovary greyish, flat and densely packed with ova which are clearly distinguishable with the naked eye. Size of the ovary ranges from 19 to 38 mm. in length. Ova large, spherical, and heavily laden with yolk. They develop a narrow perivitelline space after reaching a diameter of 0.08406 mm. They grow up to a diameter of 1.0274 mm. but the majority are larger than 0.5604 mm.

Stage IV. *Ripe*

No fish in ripe condition were present in the samples. Palekar & Karandikar (1953) also failed to encounter any ripe specimens although Bal & Joshi (1956) came across a few fish in this condition.

Stage V. *Spent*

Specimens of *C. dussumieri* in spent condition have not been recorded from Bombay waters before. Four specimens in this condition were obtained during the course of the present investigation. Ovaries flaccid, bloodshot and shrunken, measuring between 26 to 28 mm. in length. In addition to the numerous immature and small maturing ova up to a diameter of 0.5604 mm., the ovaries contained a few large residual ova of about 1.0 mm. to 1.23 mm. diameter. These were fully transparent with segmented yolk and included 10 to 15 oil globules.

(b) *Size at first Maturity*

For the purposes of determination of size at first maturity, all females with eggs larger than 0.1868 mm. were considered as maturing and classed among fish that would spawn within the next few months. The percentages of females maturing at each length group are given in Table I. The curve was found not to be a normal one when plotted on arithmetic probability paper. Holt (1959) suggests that in such a case the curve should be specified in terms of the median length of attainment of maturity and its interquartile range. The median length of attainment of maturity for *C. dussumieri* is 155.96 mm. and the interquartile range extends from 148.01 mm. to 161.83 mm.

No female *C. dussumieri* smaller than 96 mm. in total length was found to be in maturing condition. Approximately 50% of the fish in the

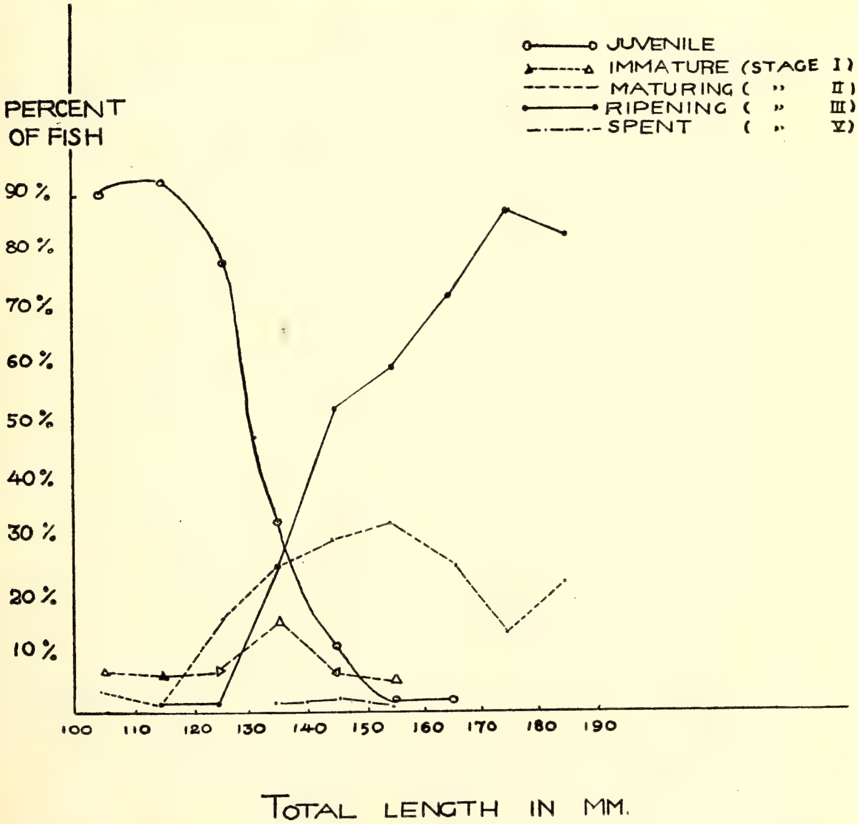

Fig. 2. Percentage of *Coilia dussumieri* at various stages of maturity in different length groups.

TABLE I

THE PERCENTAGES OF FISHES IN STAGE II AND ABOVE OF MATURITY IN EACH LENGTH GROUP

Length groups in mm.	101–105	106–110	111–115	116–120	121–125	126–130	131–135	136–140	141–145	146–150	151–155	156–160	161–165	166–170
Percentage ..	8.7	0	0	5.3	14.3	14.7	41.1	59.6	70.0	88.6	90.6	95.9	88.0	100.0

TABLE II

SEX RATIO IN THE HIGHER LENGTH GROUPS

Length group in mm.	171–175	176–180	181–185	186–190	191–195
Number of Males	32	19	14	4	2
Number of Females	22	9	3	1	0
Percentage of Males	59.3	67.9	82.4	80.0	100.0

size range 131–140 mm. and 90% of the fish at a length of 151 mm. were observed to be in maturing condition.

Figure 2 illustrates the distribution of maturity stages over the length groups at 10 mm. interval. The size range for different stages of maturity are seen to overlap to a considerable extent.

Palekar & Karandikar (1953) consider all fish over a length of 155 mm. as recurrent maturing. However, during the course of the present investigation some fish as large as 167 mm. in length were noted to be in juvenile condition, i.e., possessing undifferentiated gonads whose sex could not be distinguished. These fish had definitely not spawned before. It was not possible to class any fish as maturing for the second or subsequent times.

(c) *Sex Ratio*

Out of the 923 fish sexed, 493 were males and 430 were females. This gives a ratio of 53.41 males : 46.59 females ; this deviates significantly from the 50: 50 ratio.

Another feature of interest is the steady decrease in the proportion of females in the higher length groups (Table II). In view of the fact that fish in ripe condition were absent in the sample, it would appear that females migrate to areas beyond the normal fishing grounds at a smaller size than males, resulting in a preponderance of the latter in higher length groups.

(d) *Spawning Cycle*

The various stages of maturity for female *C. dussumieri* obtainable in the various months of the year are shown in Table III and Figure 3. Juveniles over 100 mm. in length have also been included in the analysis; 100 mm.

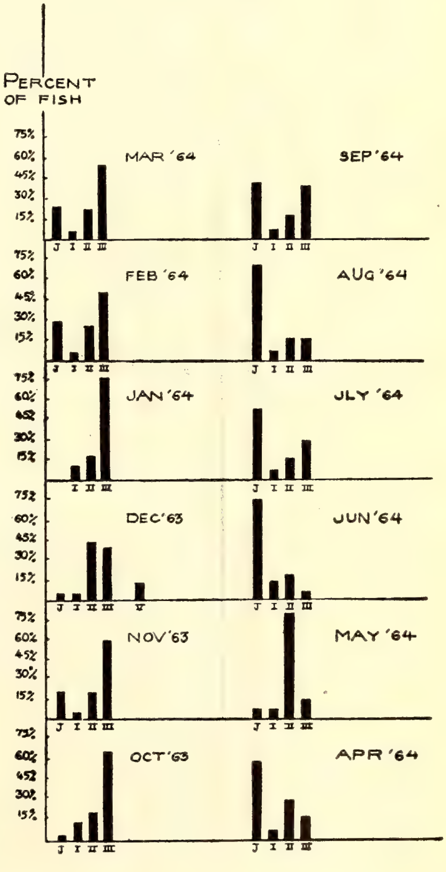

Fig. 3: Percentage of *Coilia dussumieri* ♀ at various stages of maturity in different months.

J—Juvenile; I—immature; II—Maturing; III—Ripening; V—Spent

TABLE III

NUMBER AND PERCENTAGES OF JUVENILES LONGER THAN 100 MM. AND FEMALES IN VARIOUS STAGES OF MATURITY IN EACH MONTH OF THE YEAR

		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Juvenile	No.	1	23	1	0	7	7	32	1	32	31	48	22
	%	1.4	20.0	3	0	24.2	29.9	55.2	5.9	71.2	51.7	69.6	41.5
Immature Stage I	No.	9	3	1	3	1	2	1	1	5	4	3	3
	%	12.7	2.6	3	9.5	3.3	3.2	3.5	5.9	11.1	6.7	4.3	5.7
Maturing Stage II	No.	14	23	14	5	7	7	15	13	7	3	8	8
	%	19.7	20.0	42.4	16.2	24.2	21.9	25.8	76.5	15.5	4.3	11.6	15.1
Ripening Stage III	No.	47	66	13	23	14	17	9	2	1	3	10	20
	%	66.2	57.4	39.4	74.3	48.3	53.0	15.5	11.7	2.2	5.7	14.5	37.0
Spent Stage V	No.	0	0	4	0	0	0	0	0	0	0	0	0
	%	0	0	12.2	0	0	0	0	0	0	0	0	0

is about the lowest limit at which females could be identified correctly by an examination of the gonads.

The entire absence of ripe and the very rare occurrence of spent fish in the samples studied is of special interest. Probably as has been pointed out by Palekar & Karandikar (1953) and Bal & Joshi (1956), *C. dussumieri* migrates to offshore grounds for spawning. This is further supported by the absence of eggs, larvae, and post-larvae of this fish in the inshore plankton of Bombay waters (Bal & Pradhan 1952).

Ripening (stage III) fish occur in a substantial proportion (39.4% to 74.3%) from October to March. Spent specimens are obtained only in December. The proportion of ripening (stage III) females is much lower in April (15.5%) and May (11.7%). However, it is the juveniles which occur in the largest proportion in April (55.2%), the maturing (stage II) females preponderate in May (76.5%).

It has been noted above (see Length Frequency Distribution) that there is a change in the location of fishing ground during the four months of monsoon, viz. June to September, resulting in the sampling of a different population made up of smaller and, presumably, younger individuals. The data for these four months are, therefore, not directly comparable with the data for the rest of the year. The proportion of ripening (stage III) females is lowest in June (2.2%) and quite low during July (5.7%) and August (14.5%), but rises again in September (37.0%). Palekar and Karandikar (1953) also found the ripening (stage III) fish occurring in low percentages in June, July and August.

The data suggest that the spawning season of *C. dussumieri* may extend from September to March, which months have a high proportion of ripening (stage III) females. The presence of spent fish in December is in agreement with this conclusion. However, in the absence of more direct data from fully ripe specimens or eggs and larvae, no definite conclusions can be drawn.

(e) *Spawning Periodicity*

The stages of maturity in *C. dussumieri* vary considerably among individuals, and generally at any one time of the year fishes at all stages of maturity are commonly seen. In order to demonstrate any periodicity in spawning, the data were grouped according to the location of the largest mode in the diameter frequency of the ova from each fish (Clark 1934 ; Howard & Landa 1958 ; Joseph 1963).

Table IV and Figure 4 show the mean percentage ova diameter distribution of the ova measurements of females grouped into nine classes resulting from this method. Classes B, C, D and E are maturing stage (III) females ; classes F, G, H and J are ripening (stage IV) females, and class

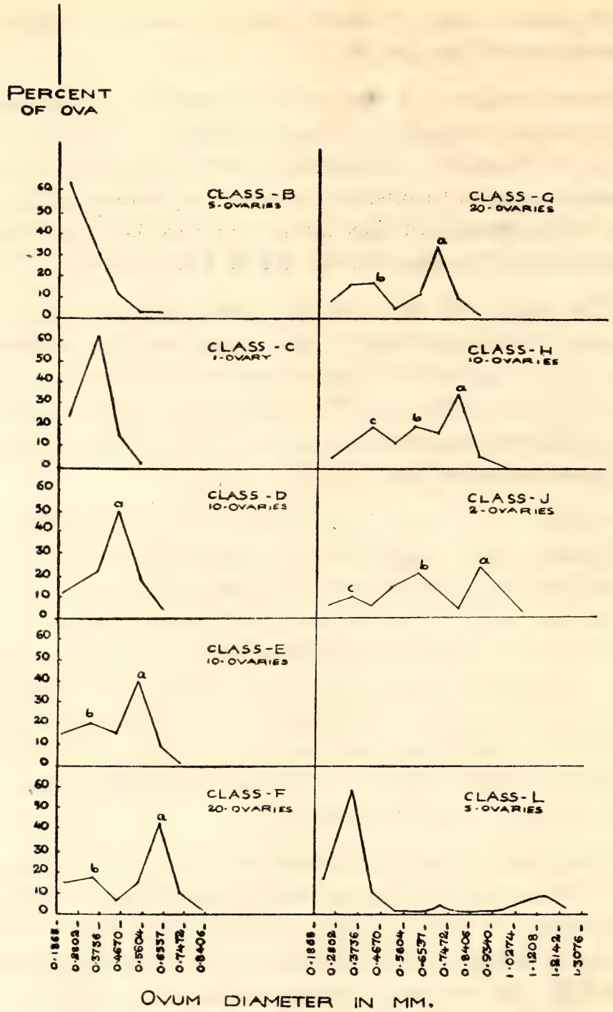

Fig. 4. Size frequency distribution of intraovarian eggs of *Coilia dussumieri* in various stages of maturity.

L belongs to the spent stage of maturity. Ova diameter measurements were not actually carried out from immature females. Eggs smaller than 0.1868 mm., which were present in large numbers, were omitted.

The ova diameter frequency polygons indicate that the fish has a protracted spawning period. The batch of maturing eggs is not sharply differentiated from the general egg stock. Other groups of ova, with distinct modes lying between the general egg stock and the last mode, appear to be progressing towards maturity. This multiplicity of modes in the

TABLE IV

FREQUENCY PERCENTAGES OF OVA DIAMETERS IN VARIOUS CLASSES

Class	B	C	D	E	F	G	H	J	L
No. of ovaries	5	1	10	10	20	20	10	2	3
0.2055 to 0.2802 mm.	60.0	24.0	14.6	14.8	14.8	6.2	3.0	4.7	20.0
0.2989 to 0.3736 mm.	28.7	60.4	19.8	18.3	16.2	15.5	11.4	7.7	55.1
0.3923 to 0.4670 mm.	8.3	14.6	47.8	14.3	5.0	16.2	18.0	5.3	9.7
0.4857 to 0.5604 mm.	1.4	1.0	16.3	39.8	13.0	4.2	11.5	13.6	1.4
0.5791 to 0.6537 mm.	0.2		0.6	10.2	41.7	10.5	2.0	19.5	0
0.6724 to 0.7472 mm.				0.7	8.8	37.6	15.0	11.5	0.4
0.7659 to 0.8406 mm.					0.5	9.5	33.0	2.9	0
0.8592 to 0.9340 mm.						6.3	5.0	22.7	0
0.9527 to 1.0274 mm.							1.1	11.7	1.3
1.0460 to 1.1208 mm.								0.8	4.8
1.1395 to 1.2142 mm.									6.5
1.2329 to 1.3076 mm.									0.8

frequency curves of ova diameters from maturing females suggests that each individual spawns more than once during the breeding season.

An estimate of the total number of possible spawnings may be made from the ratio of the number of ova in the most advanced mode to the number of remaining maturing eggs (MacGregor 1957). This data is presented in Table V. The eggs in the most advanced mode are quite sharply defined in class F and the following classes. In the class F gonads, the eggs in the advanced mode make up 66.5% of the total as compared to 33.5% made up by the remaining maturing eggs. This ratio falls from 66.5% in class F to 60.0% in class G, to 55.1% in class H, and further to 36.65% in class J. Thus, it appears that new eggs are constantly being added to the stock of maturing eggs. Assuming that all the maturing eggs are spawned, the number of possible spawnings may be fixed at a minimum of three, the number of ova in the most advanced mode in class J being about $\frac{1}{3}$ the total number of maturing ova. Since there is no information concerning this ratio in a ripe ovary, no definite estimate of the number of spawnings can be made. It is possible that more ova are added to the stock of maturing ova as the ovary ripens and that this ratio falls below $\frac{1}{3}$. The eggs may then be spawned in more than three batches.

TABLE V

PERCENTAGES OF SMALLER YOLKED OVA AND OVA IN THE MOST ADVANCED GROUP (MODE A) IN THE VARIOUS CLASSES

Class	F	G	H	J
% of ova other than included under mode a	33.50	40.0	44.9	63.35
% of ova in mode a	66.50	60.0	55.1	36.65

(f) *Ponderal Index*

In the present investigation the ponderal index was calculated by the formula :

$$K = W/L^3 \times 10^7$$

where K = Ponderal Index
W = Weight of fish in gm.
L = Total length of fish in mm.

The values of the ponderal index were pooled in two ways to find the arithmetic means of each size group and of each month. These have been presented in Figures 5 and 6.

Hart (1946) pointed out that since adolescent fish have higher K values than older fish, the variation in the K values at different lengths

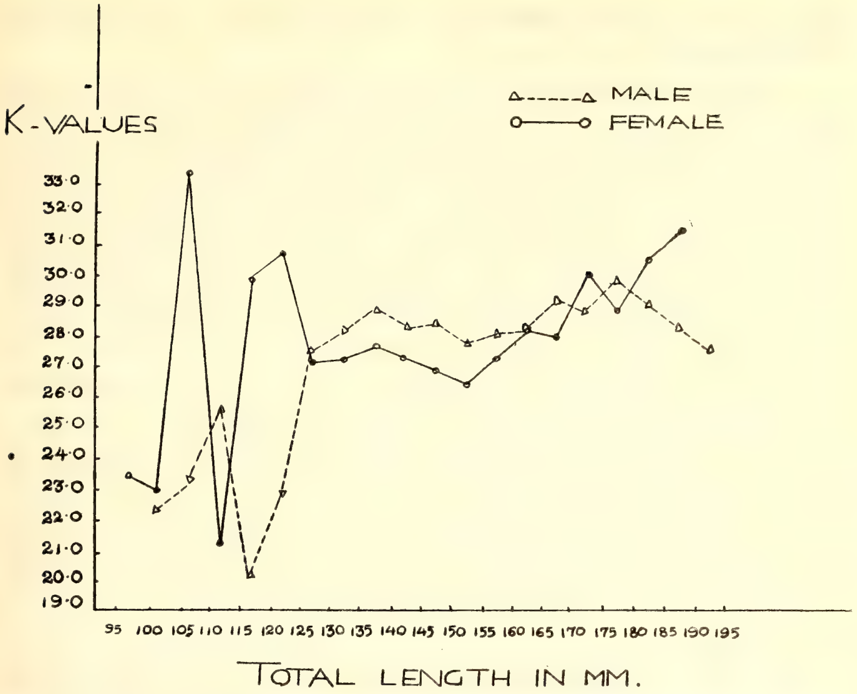

Fig. 5. Mean condition factor (K) of *Coilia dussumieri* at different lengths.

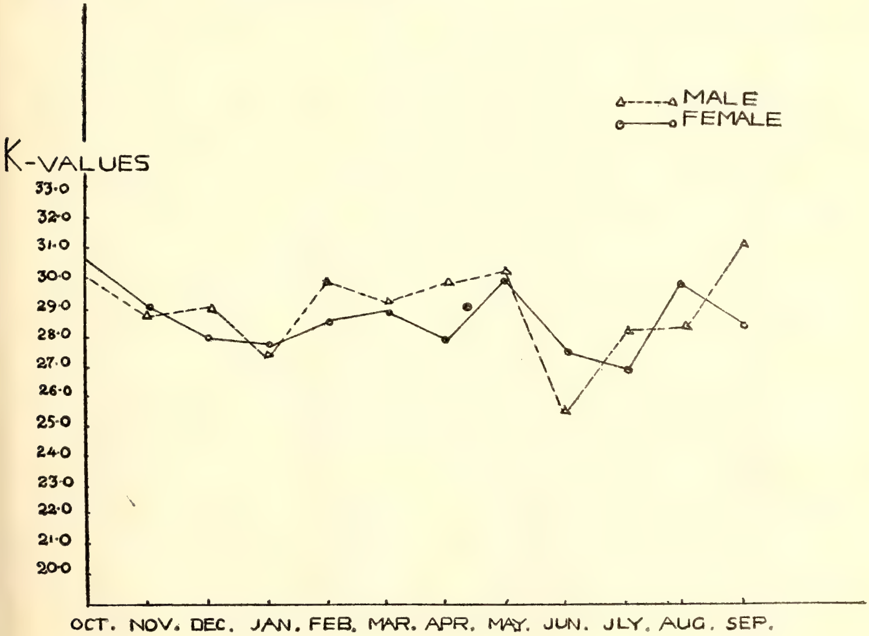

Fig 6. Mean condition factor (K) of *Coilia dussumieri* in different months.

can be employed to determine the size of first maturity, at which point an inflexion may be expected to occur.

In the present case, there is no point of inflexion in the curve which may indicate the size at first maturity. The values of K seem to be fluctuating without much indication between the 91-95 mm. and 121-125 mm. length groups in both sexes. Thereafter, the fluctuation is within narrower limits. On the basis of gonadial studies, 131-140 mm. was considered to be the size at first maturity in females. The curves for both the sexes change slope at this point, which is more marked in females than in males. One may regard this point as corresponding to the point of inflexion as suggested in *Ophicephalus punctatus*, by Qayyum & Qasim (1964 *a*). The absence of any distinct pattern in K values at various lengths groups may be due to the wide range of size of the fish at various stages of maturity.

Seasonal variations in the ponderal index have been illustrated in Figure 6. As no ripe fish and only a few spent fishes were found, the condition factor may not be expected to record a fall due to metabolic strain consequent upon spawning. The seasonal fluctuations in K values, therefore, do not indicate the spawning season of the fish.

(g) *Fecundity*

Estimates of fecundity from 21 specimens ranged from 1,200 to 4,200. The total number of eggs spawned by each individual in a season may be estimated at 3,600 to 12,600 as the spawning probably occurs thrice during the season. The details of fecundity counts are given in Table VI.

TABLE VI

TOTAL LENGTH, BODY WEIGHT, GONAD WEIGHT AND FECUNDITY ESTIMATES OF 21 SPECIMENS OF *Coilia Dussumieri*

Total length	Body weight	Gonad weight	Fecundity
15.1	10.8	0.127	1191
14.7	8.2	0.368	1556
17.1	13.3	0.678	2033
14.9	16.3	0.408	2047
16.3	12.9	0.928	2150
17.0	12.0	0.435	2234
16.4	12.0	0.516	2267
16.3	11.9	0.598	2361
16.3	13.9	0.717	2407
15.9	12.4	0.545	2450
16.1	11.4	0.633	2480
15.5	9.8	0.470	2508
16.0	11.8	0.601	2535
17.3	15.7	0.964	2682
15.9	10.4	0.490	2715
16.7	13.2	1.068	2743
14.5	10.5	0.713	2760
15.6	12.2	0.725	2888
15.8	17.0	0.458	2899
17.7	16.8	0.942	3004
17.3	16.4	1.1015	4214

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Falconry

BY

S. M. Osman

(*With two plates*)

The art and practice of falconry has been described in many treatises in different languages but very few people know anything about it. There has always been considerable controversy regarding its origin, though there is historical evidence that it has been in existence from *c.* 1200 B.C. Falconry probably originated in Central Asia from whence it spread to Persia and India. The Arabs learned it from the Persians, and it was brought to Europe by the returning Crusaders, who undoubtedly learnt the art from the Arabs.

In the beginning, falconry was perhaps primarily a means of providing man his daily food; today it survives as an unparalleled sport which demands of its devotees, great skill, endurance, and patience.

In India, at one time the stronghold of falconry, its science and practice is now rapidly declining. In my opinion, different causes have contributed towards its downfall. The shotgun is mainly responsible for accelerating the disappearance of this noble sport. There used to be a time when the hawk market of Amritsar would, in the months of October and November, offer for sale numerous hawks and falcons of different kinds. The clientele were the representatives of all the sporting Princes of the country, who vied with one another for some really good hawk or falcon. Today the number of hawk enthusiasts in the country could be counted on the fingers of one hand and the hawk market of Amritsar has ceased to exist. The aspiring falconer finds it difficult to get hawks. Bird catchers have absolutely no idea how to catch hawks or, how to handle them after capture. As a result hawks procured from such sources generally die within a few days of their capture. As is obvious, mishandling and bad feeding are entirely responsible. Since falconry is no longer a lucrative business, professional falconers have ceased to function. I prefer to trap my own hawks.

Though not much in vogue, there exist excellent possibilities for the revival of this sport of kings. The main point to remember in its pursuit is the choice of bird and this is directly related to the type of country one lives in, as well as to the kind of game available. Falcons are at their best in open and flat country where the quarry is obliged to fly long distances before gaining the shelter of bushes. In places where there are many trees and thick bushes growing at short intervals, the "Accipiter" hawks are in their element. In such terrain a bird capable of short determined dashes alone is useful. One has also to consider the game available in terms of speed and weight. In the case of hawks and of falcons a wide range of birds, capable of hunting heavy and light game, is to be found. One should not expect a small hawk to do the work of the larger ones, or the heavier birds to have the dash and manoeuvrability of the smaller predators.

I have always had a great passion for training eagles and, even today, have with me a pair of fully trained hunting eagles. Hunting with eagles is an incomparable sport.

The Sparrow-Hawk (*Accipiter nisus*) if trained and handled properly would be an ideal beginner's hawk. These birds may be found in great abundance along the foothills of the Himalayas. They have courage and speed, and will readily tackle birds heavier than themselves. Their only weak point happens to be their delicate constitution which calls for much attention and careful handling. This, a beginner may be unable to give, hence I would suggest the Shikra Sparrow-Hawk (*Accipiter badius*) as an alternative. Though slightly smaller in size, this hawk will stand a lot of mishandling at the hands of inexperienced falconers without showing any signs of loss of condition. A lusty hawk, if properly trained to hunt, it will perform as efficiently as its bigger brother the Sparrow-Hawk (*Accipiter nisus*). The Shikra is, of course, a lot slower but this can be overcome to some extent by holding the bird in the palm of your hand and literally throwing it at the quarry. This form of casting is intended to give the hawk added impetus. Such liberties are not possible with the more sensitive Sparrow-Hawk. The Goshawk (*Accipiter gentilis*) is the best amongst hawks of all kinds. It is an extremely shy bird, very sensitive, and quite difficult to train. Once trained, however, it is unsurpassed for close quarter hunting. A falconer who does not consider himself an expert should give this bird a wide berth.

Broadly speaking all hawks receive the same sort of training. They are cast from the fist at game and, if unsuccessful, are called back to the fist, in which is firmly held a piece of meat. A hawk must never be given a chance to soar. Once a hawk starts soaring no amount of calling is ever going to bring it back to the owner's fist. When it ultimately decides to return to earth, it is going to be a good many miles away from the place from which it originally took off.

A falcon on the other hand receives a totally different sort of training. In this case the higher it soars and the longer it keeps soaring, the better will it be appreciated. Falcons are trained to wait at considerable heights, till game is flushed from cover. Once game is forced to come out in the open, the attending falcon immediately stoops at it from above, where it had kept watch. Given proper conditions, the chances are that the quarry will be struck dead before it has been able to gain the sanctuary of the next lot of bushes and cover. Falcons are not called to the fist but to the lure, which is merely a weighted leather bag about the size of the human fist. Attached to it are the wing feathers of a pigeon; also tied to one end is a stout cord some twelve feet in length. This the falconer swings over his head at the same time calling out aloud to attract the falcon's attention. After swinging the lure a couple of times he lets it drop on the ground. It is then slowly retrieved, and the swinging operation repeated till the falcon decides to fly down to it.

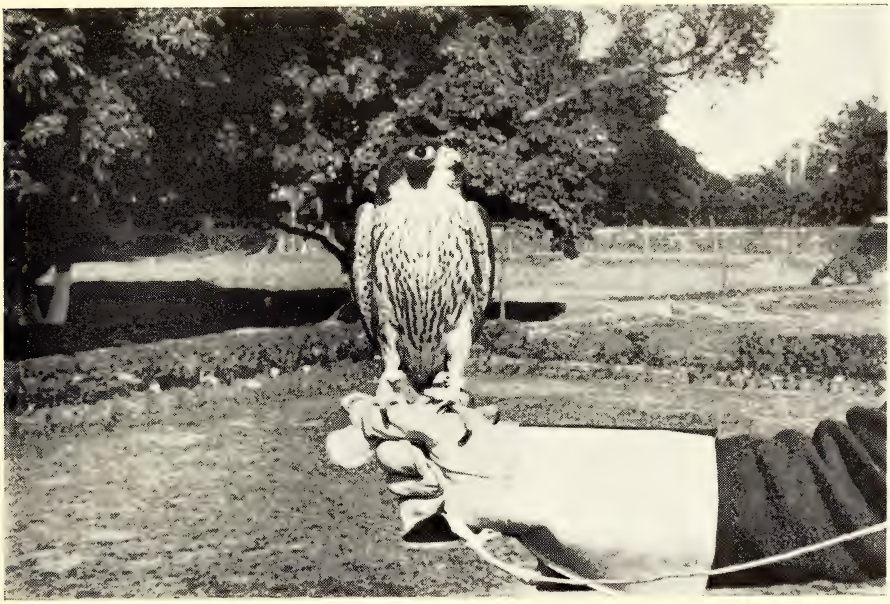
Eagles are trained to jump to the fist. They are also trained to fly to the lure when necessary. To give a detailed description of the various methods of training of the different hawks and falcons would be quite beyond the scope of an article of this kind. As a matter of fact many books have been written on the subject. However, unless there is at all times a guide at the beginner's elbow, no amount of written literature is ever going to help a raw hand with his first hawk; hence the necessity of falconers' clubs. Membership of such clubs would entitle the beginner to free advice and demonstrations.

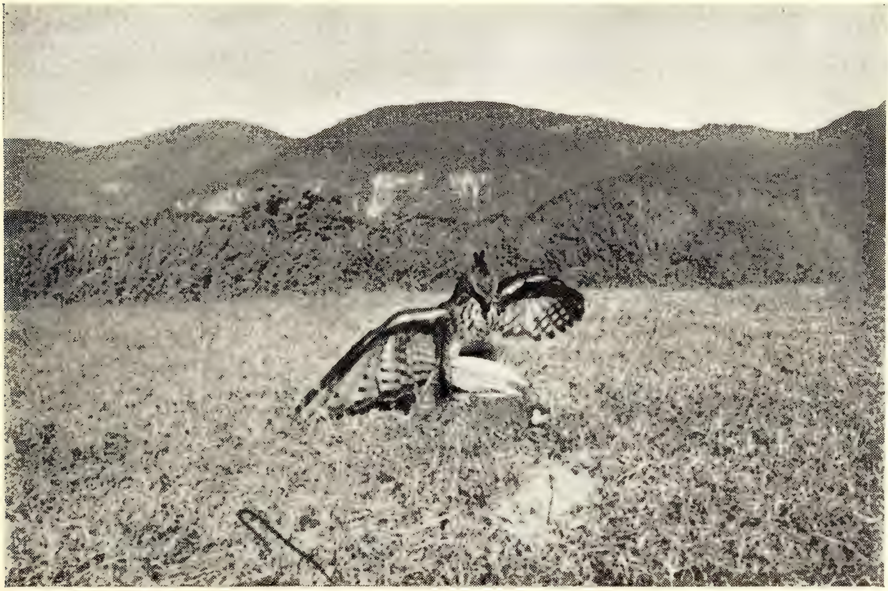
The most important thing for a falconer to know, is the difference between hawks and falcons. To the experienced eye, this is easy and provided he makes it a point to remember, even the inexperienced novice can easily tell one from the other. All hawks have yellow eyes and all falcons have black eyes. True eagles can always be identified by their feathered legs.

There are many kinds of falcons. The smallest being the Red-headed Merlin or turumti (*Falco chicquera*). A pretty bird, it has some peculiarities that are not present in other falcons, barring the Gyrfalcon (*Falco rusticolus*). The similarity lies in the formation of the primary feathers in relation to the tail feathers. It will be noticed that in the case of the Merlin and the Gyrfalcon the tips of the primary feathers fall short of the end of the tail feathers by some inches. Another peculiarity is that merlins do not soar. I have trained and hunted with dozens of these stout-hearted birds, but so far, I have yet to come across a merlin, that will soar in the manner of other falcons. This is the only case where a falcon departs from convention and must in consequence, be treated like a hawk. In this case the lure would be an unnecessary appendage; this is the main reason why merlins are trained to fly to the fist of the falconer, a line of training not dissimilar to the one given to hawks in general. A merlin may chase game and, in doing so, rise up in spirals, but this is not real soaring.

A notch is present on the beak of all falcons. Nature has provided this notch so that the falcon, after wedging the neck of its prey between it and the lower mandible, is able with a sharp twist to break it. Those

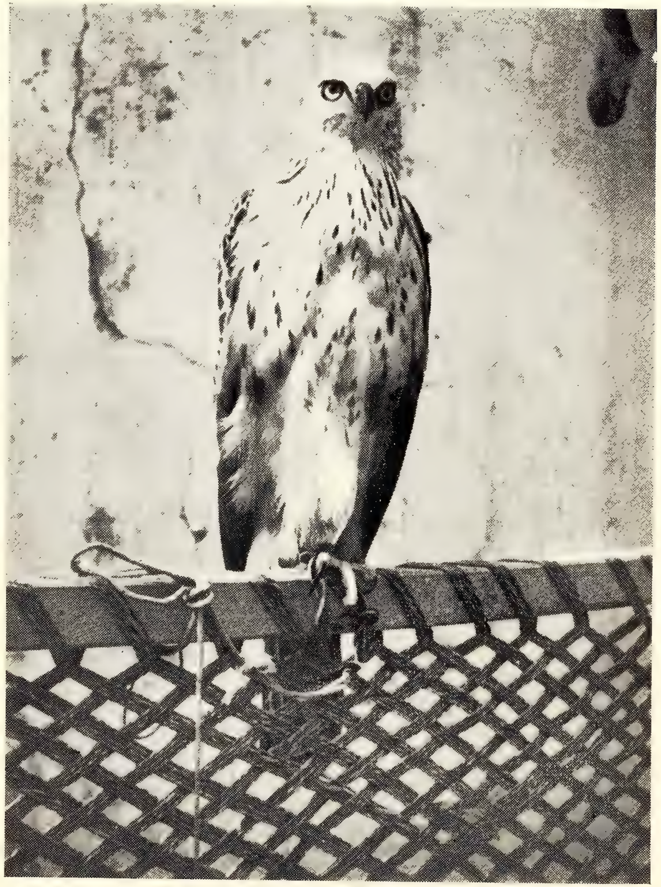
Osman: Falconry



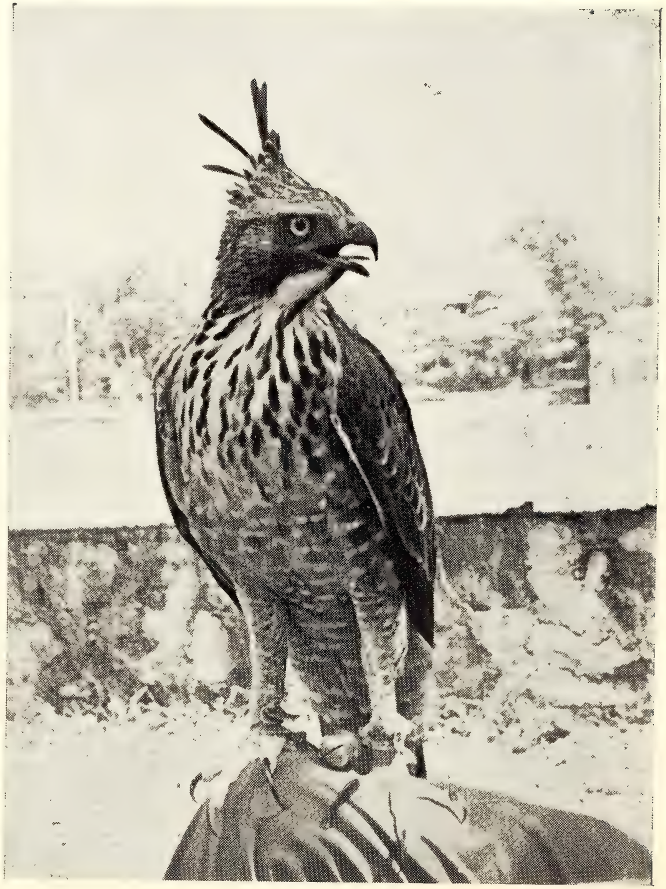


Above: Shahin Falcon (*Falco peregrinus peregrinator*), Tiercel.
Below: Hodgson's Hawk-Eagle (*Spizaetus nipalensis*), on quarry.

(*Photos: Author*)



Crested Hawk-Eagle (*Spizaetus cirrhatus*)



Hodgson's Hawk-Eagle (*Spirzaetus nipalensis*)

(***Photos: Author***)

who know their birds of prey will have noticed that all falcons kill their victims by twisting and breaking their necks. Hawks kill their victims not by twisting their necks but by repeatedly squeezing them.

You do not have to be a hawk expert to be able to roughly place its age. All that is required is a close examination of the bird's eye. Immature birds (juvenile birds) have the iris a pale yellow in colour. In birds that are two to three years of age the iris changes to an orange tint. Five-year-olds have a deep red iris. Sometimes a very old bird, say ten or twelve years old, may even have copper-tan coloured iris. In most hawks, excepting the sparrow-hawk, the markings on the breast of the juvenile bird, are elongated spots. After the first moult, the spots disappear and are replaced by bars. This is a regular feature noticeable in hawks as well as falcons of the peregrine (*peregrinator*) group. In other falcons it is not very easy to tell the age, unless one has considerable experience. Here one does not find any tell-tale change in the colour of the iris. Old birds are lighter in colour and their tails are shorter than the tails of immature birds. Age determination becomes the job of an expert, especially in the case of desert falcons such as the Lanner Falcon (*Falco biarmicus*), the Saker Falcon (*Falco cherrug*), and the Laggar Falcon (*Falco jugger*).

Falcons are some of the fastest birds on earth and nature has, in consequence, provided them with a complicated nostril structure which makes respiration comparatively easy for them while travelling at high speed. Without such complex nostril mechanism it would be impossible for the falcons to breath normally, while travelling at speed. Another point clearly noticeable in all falcons is the moustachial stripes under the eyes. The purpose of these stripes is to absorb light and thus to reduce glare.

Falconry is one of the finest sports known to man. Style and skill are of paramount importance, and it is not the number of kills but the manner in which the kill is made that really matters. One has further to realise that in the case of falconry the question of game getting away wounded to die in agony simply does not arise. Either it is killed outright or it escapes unscathed.

In India, unfortunately, the days of falconry are numbered and if no immediate steps are taken to revive the sport, it will never return.

Books are useful to the practical falconer, though for the beginner, it would be rather difficult to get very far by reading alone. In any case, a list of important books on falconry, published in different languages, is given below.

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Additions to the Flora of Mussoorie Hills

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In the botanical literature the first mention of Mussoorie is found in Royle's *Ill. Bot. Himal.*, published in 1833-1840. U.N. Kanjilal (1928) in Flora Chakrata also mentions Mussoorie in giving the distribution of some species. Besides, notable contributions to the flora of Mussoorie have been attempted since 1909 when James Marten published a list of 314 species of flowering plants. Then Allen (1919) added 32 species and Watts (1954) published further records of 41 species, and estimated the number of plants that comprise the flora of Mussoorie as between 700-750 species. Recently Raizada (1959) published a list of plants occurring in Mussoorie, raising the number of species of Phanerogams, Ferns, and Fern Allies to 1331. The following is a further list of plants which are reported for the first time from the Mussoorie Hills. The area of collection is the same as was considered by Raizada (1959). Cultivated plants and plants found as escapes have not been included in the list, unless they have been found naturalized in the area.

RANUNCULACEAE

Clematis orientalis L.

Mossy Fall, in shady places. Fl. Aug.-Sept.

Ranunculus arvensis L.

Occasional weed of cultivation, below Bhatta-Dhobighat. *Saxena* 1677. Fl. Feb.-March. Fr. March-April.

Thalictrum javanicum Bl.

Common along waysides in shady places. Rajpur, Kamptee Fall, etc. *Saxena* 1226, 1301. Fl. July-Oct. Fr. Oct.-Nov.

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MENISPERMACEAE

Stephania glabra (Roxb.) Miers.

Rajpur 1000 m. along waysides in thickets and over shrubs. *Saxena* 1297, 2107. Fl. July-Aug. Fr Aug.-Oct.

Loc. name: *Para* or *Parha*

BERBERIDACEAE

Mahonia acanthifolia G. Don.

Occasional in oak forests, 1700-2100 m. Kamptee Road, Masonic Lodge, Barlowganj, near Charleville, Koeti Kimoen Forest etc. *Saxena* 314, 2349. Fl. Feb.-April. Fr. May-June.

Loc. name: *Totar*

CRUCIFERAE

Arabidopsis thaliana (L.) Heyn.

Rajpur, along waysides in open dry places. *Saxena* 376. Fl. & Fr. Jan.-March.

Coronopus didymus (L.) Sm.

In open, somewhat moist spots at Kulri, Bhatta-Dhobighat etc. Along stream at Mossy Fall. *Saxena* 619, 755, 1556. Fl. & Fr. April-Dec.

Eruca sativa Gars.

Rajpur, up to 1050 m.—Occasional along waysides and in waste lands near settled areas. *Saxena* 226. Fl. Jan.-Feb.

Lepidium ruderale L.

Along waysides in waste lands and in fields, 915-2050 m. Rajpur, Bhatta-Dhobighat, Mall Road, Jabarkhet Road etc. *Saxena* 674, 753. Fl. May-June. Fr. July-Sept.

CAPPARIDACEAE

Capparis zeylanica L.

Occasional at Rajpur. *Saxena* 411. Fl. March-May. Fr. June-Sept.

Cleome viscosa L.

A weed in fields and along roadsides, 915-1500 m. Rajpur, Kamptee etc. *Saxena* 1973. Fl. June. Fr. July-early Oct.

Loc. name: *Jakhia*

FLACOURTIACEAE

Casearia tomentosa Roxb.

Frequent up to 1200 m. especially south of Mussoorie; Rajpur, Kutalgaon etc. Sometimes in sal forests. *Saxena* 408, 1732, 1758, 1902. Fl. March-April. Fr. May-July.

Loc. name: *Chilla*

PORTULACEAE

Portulaca oleracea L. subsp. **silvestris** (DC.) Thellung.

A common weed along roadsides at Rajpur; and in and along fields in moist spots at Arnigarh. *Saxena* 2810, 1989. Fl. June-Sept. Fr. Sept.-May.

MALVACEAE

Abelmoschus manihot (L.) Medic. var. **pungens** (Roxb.) Hochr.

Kamptee, scarce in open places. *Saxena* 2241, Fl. Sept.

Malva verticillata L. var. **chinensis** (Mill.)

Occasional along waysides at Kulri, Depot, near Jabarkhet etc. *Saxena* 970, 1353, 2049. Fl. & Fr. July-Sept.

The elongated pedicels and small flowers of this variety misled some authors to name it as *Malva parviflora.* The latter species has glabrous staminal tube and manifestly reticulate carpels with sharp edges.

Sida cordifolia L.

Occasional in open dry and often stony waste places at Rajpur, Kutal Gate, Kamptee Road etc. *Saxena* 1389, 2232. Fl. & Fr. Sept.-Nov.

TILIACEAE

Corchorus olitorius L.

A weed in *Arhar* field at Rajpur. *Saxena* 1316, 2224. Fl. Aug.-Sept. Fr. Sept.-Oct.

Grewia subinaequalis DC.

Occasional at Rajpur, both cultivated and wild. *Saxena* 1886, 1975, 2118. Fl. April-May. Fr. June-July.

Triumfetta pentandra A. Rich.

Fairly common in open or shady waste places at Rajpur, Kutal Village, Kamptee etc. *Saxena* 1038(A), 1191, 1329(A). Fl. & Fr. Aug.-Nov.

OXALIDACEAE

Biophytum reinwardtii (Zucc.) Klotz.

Occasional in open places at Rajpur and Kamptee. *Saxena* 1062. Fl. & Fr. Late Aug.-Sept.

RUTACEAE

Aegle marmelos (L.) Corr.

Cultivated and also apparently wild at Rajpur. *Saxena* 1977. Fl. June-July. Fr. June (next year).

VITACEAE

Parthenocissus semicordata (Wall.) Planch. var. **semicordata.**

Occasional in oak forest along Municipal Garden Road. *Saxena* D.D. No. 138679. Fl. June.

The var. *semicordata* (proper) differs from var. *roylei* in the hispid nature of the young branches, petioles, and nerves on the lower surface of the leaves.

Tetrastigma affine (Gagnep. ex Osmaston) Raizada & Saxena comb. nov *Vitis affinis* Gagnep. ex Osmaston, For. Fl. Kumaon 119, 1927.

A climber on rocks and in crevices; Jharipani (Oak Grove), Barlowganj, Bhatta Fall etc. *Saxena* 260, 1460, 1661. Fl. July-Sept. Fr. Oct.-March.

ANACARDIACEAE

Spondias pinnata (L.f.) Kurz.

Rare at Rajpur and up to 1100 m. on the Motor Road. *Saxena* 1926. Fl. March-April. Fr. June-Sept.

Loc. name: *Amara* or *Amra*

PAPILIONACEAE

Alysicarpus bupleurifolius (L.) DC. var. **bupleurifolius.**

Rajpur, occasional in open places. *Saxena* 2331. Fl. & Fr. Sept.

Atylosia volubilis (Blanco) Gamble.

Rajpur, occasional in sal forest. *Saxena* 1629. Fl. Feb.-March. Fr. March-April.

Crotalaria alata Buch -Ham. ex Roxb.

Rajpur, rare in sal forest. *Saxena* 2304. Fl. Aug.-Sept. Fr. Oct.

Crotalaria humifusa Grah. ex Benth.

Rare, on open grassy slopes at Kamptee Fall and Murray's Spring. *Saxena* 2255. Fl. Sept. Fr. Oct.-Nov.

Crotalaria medicaginea Lamk.

Occasional, in open places at Kamptee Fall. *Saxena* 1404, 2245. Fl. Aug.-Sept. Fr. Sept.-Oct.

Crotalaria mysorensis Roth.

Rare, in open places at Rajpur. *Saxena* 1446(B), 2208. Fl. Sept.-Oct. Fr. Oct.-Nov.

Crotalaria prostrata Rottl.

Occasional, near sal forest, Rajpur, usually in sheltered places. *Saxena* D.D. No. 138668. Fl. Late Aug.-Oct. Fr. Oct.-Nov.

Crotalaria tetragona Roxb.

Rare, in sal forest, Rajpur. *Saxena* 1771. Fl. Sept.-Nov. Fr. March-June.

Dalbergia sissoo Roxb. ex DC.

Frequent at Rajpur, ascending to 1400 m. on Rajpur- Mussoorie Motor Road. *Saxena* 396. Fl. March-May. Fr. Nov.-Feb.

Indigofera linifolia (L.f.) Retz.

Along waysides in open stony ground at Rajpur. *Saxena* 1314, 1885. Fl. March-Sept. Fr. Sept.-Oct.

Lathyrus aphaca L.

Occasional on Kamptee Road; frequent in fields below Bhatta Dhobighat. *Saxena* 347, 1671. Fl. & Fr. Feb.-May.

Melilotus indica All.

Occasional along waysides and drains at Rajpur, ascending to 1220 m. *Saxena* 277, 1683(B), D.D. No. 138640. Fl. & Fr. Nov.-April.

Pueraria phaseoloides (Roxb.) Benth.

Rajpur, frequent in sal forest. *Saxena* 2205. Fl. Aug.-Sept. Fr. Sept.

Rhynchosia falconeri Baker

Occasional, in open places at Kamptee, Murray's Spring, near Cloud End and in the grasslands of Benog. *Saxena* 1193, 1282, 1505. Fl. Aug.-Sept. Fr. Oct.-Nov.

Shuteria densiflora Benth.

Occasional at Rajpur. *Saxena* 1595 Fl. Oct.-Nov. Fr. Dec.

Smithia conferta Sm.

Rajpur, common in moist places near sal forest. *Saxena* 2299(B). Fl. Sept.-Oct. Fr. Oct.-Nov.

Smithia sensitiva Ait.

Rajpur, sal forest in somewhat moist situations. *Saxena* 1580, 2299(A). Fl. Sept.-Oct. Fr. Dec.

Trigonella corniculata L

Rajpur, occasional along roadsides in waste lands. *Saxena* 1753. Fl. March-April. Fr. April-June.

Trigonella polycerata L.

Along roadsides at Rajpur. As a weed in wheat fields at Kamptee. *Saxena* 1756, 1841. Fl. & Fr. March-May.

Uraria rufescens (DC.) Schind.

Occasional in sal forest, Rajpur. *Saxena* 2303. Fl. Aug.-Sept. Fr. Sept.-Oct.

CAESALPINACEAE

Cassia laevigata Willd.

Occasional along fields below Bhatta-Dhobighat and also near Bhatta Toll Bar. *Saxena* 850, 1378. Fl. July-Sept. Fr. Oct.-Dec.

Cassia pumila Lamk.

Frequent along waysides, in open places near Kamptee Rest House. *Saxena* 1203. Fl. July-Aug. Fr. Sept.-Oct.

ROSACEAE

Rubus foliolosus D. Don.

Occasional on the way to Park Gate and Barlowganj. *Saxena* 632, 906. Fl. & Fr. April-Sept.

Loc. name: *Anchu*

COMBRETACEAE

Combretum roxburghii Spreng.

Occasional at Rajpur. *Saxena* 2343. Fl. Nov.-Dec.

Terminalia bellirica Roxb.

Rare on the Bridle Path above Rajpur up to 1050 m. and in sal forest. *Saxena* 1788. Fl. April-May. Fr. Dec.-Feb.

MYRTACEAE

Syzygium cerasoides (Roxb.) Chatt. et Kanj.

Occasional in sal forest, Rajpur. *Saxena* 1913. Fl. April-May.

Loc. name: *Piyanam*

Syzygium cumini (L.) Skeels.

Frequent in sal forest and often cultivated at Rajpur. *Saxena* 530, 1887. Fl. April-May. Fr. June-July.

LYTHRACEAE

Ammannia baccifera L.

Kamptee Fall, in wet rice fields. *Saxena* 1548, 2247. Fl. & Fr. Sept.-Nov.

Ammannia multiflora Roxb.

Kamptee Fall, abundant in wet rice fields. *Saxena* 1546, 2099. Fl. & Fr. July-Nov.

Rotala mexicana Cham. & Schlecht.

Gregarious in open moist spots near sal forest, Rajpur. *Saxena* 2293. Fl. & Fr. Late Sept.-Oct.

Rotala rotundifolia (Buch.-Ham.) Koehne.

Abundant in and around water ditches near sal forest, Rajpur. Aquatic or in marshy places. *Saxena* 1634, 2091. Fl. Feb.-March.

CUCURBITACEAE

Bryonopsis laciniosa (L.) Naud. var. **laciniosa**.

Occasional in waste places at Rajpur. *Saxena* 1286. Fl. & Fr. Sept.-Oct.

Cucumis sativus L.

Common at Rajpur, ascending to 1200 m. Occasional at Kamptee Fall and Charleville. *Saxena* 1032, 1396, 2139. Fl. Aug.-Sept. Fr. Oct.

Except fruits, which are very bitter in taste, *C. hardwickii* Royle is similar in all essential characters to *C. sativus* L. The two species are now considered conspecific. It is the (bitter) form *C. hardwickii* which occurs wild in the area.

CACTACEAE

Opuntia monacantha Haw.

Occasional in dry waste lands at Rajpur; rare at Jharipani. *Saxena* 1918. Fl. April-May.

Loc. name: *Soru*

UMBELLIFERAE

Bunium persicum (Boiss.) Fedt.

Occasional along roadsides near Kincraig and Barlowganj. *Saxena* D. D. No. 139182. Fl. Nov.

Trachyspermum ammi (L.) Sprague.

Rare, near Jabarkhet. *Saxena* 1365. Fl. Sept.-Oct.

RUBIACEAE

Adina cordifolia (Roxb.) Hook f.

Occasional in sal forest, Rajpur. *Saxena* 1628. Fl. June-July. Fr. Cold season.

Loc. name: *Haldu*

Galium vestitum D. Don.

Along waysides, 1500-2200 m. Kamptee, Arnigarh, Landour, Benog etc. *Saxena* D. D. No. 138334. Fl. & Fr. Aug.-Oct.

Hedyotis pinifolia Wall. ex G. Don.

Occasional in somewhat moist and grassy places in and near sal forest, Rajpur. *Saxena* 1438(B), 2308, 2337. Fl. & Fr. Sept.-Oct.

Knoxia sumatrensis (Retz.) DC.

Rajpur, occasional in sal forest. *Saxena* 2097, 2306. Fl. Aug.-Sept. Fr. Sept.-Oct.

Oldenlandia diffusa (Willd.) Roxb.

Rajpur, in moist and grassy places near sal forest. *Saxena* 2084. Fl. & Fr. July-Sept.

Randia dumetorum Lamk.

Occasional in open places at Rajpur, Kutal village etc. *Saxena* 1900. Fl. April-June. Fr. Cold season.

Loc. name: *Maidal*

COMPOSITAE

Ageratum houstonianum Mill.

Common in waste places at Rajpur, Jharipani etc. *Saxena* 201. Fl. & Fr. Nov.-March.

Artemisia vulgaris L.

Common along waysides and in forest. Jabarkhet Road, Kamptee Road, Benog, Murray's Spring Forest etc. *Saxena* 1186. Fl. & Fr. Aug.-Oct.

Loc. name: *Chhamra* (*Samri*)

Blainvillea acmella (L.) Philipson

Common in fields at Rajpur. Occasionally ascending to 1200 m., near Katta Patthar. *Saxena* 1325, 1453, 2171. Fl. & Fr. Aug.-Nov.

Blumea mollis (D. Don) Merr.

Frequent along waysides and in waste lands, 915-1300 m. Rajpur, Ramtirth Ashram, Bridle Path etc. *Saxena* 563, 1726. Fl. & Fr. March-June.

Blumea laciniata (Roxb.) DC.

Occasional along waysides in somewhat dry places, 915-1500 m. Rajpur, Kutal Gate, Bhatta Fall etc. *Saxena* 591, 1817, 1882. Fl. & Fr. March-May.

Centipeda minima (L.) A. Br. & Aschers.

Bridle Path (1500 m.), rare in dry places. *Saxena* 1452. Fl. & Fr. June-Nov.

Cnicus argyracanthus (DC.) C.B.Cl.

Common in waste lands at Barlowganj. *Saxena* 577. Fl. & Fr. Late May-Sept.

Elephantopus scaber L.

Rajpur, rare in sal forest. *Saxena* 2300. Fl. Oct.

Erigeron annuus Pers.

Common and often gregarious in open or somewhat shady places, 1500-2000 m. Camels Back Cemetery, Barlowganj, Kamptee Road, Municipal Garden, near Mossy Fall, way to Murray's Spring etc. Fairly naturalized. *Saxena* 358, 667, 692. Fl. April-Aug. It is a native of America.

Eupatorium adenophorum Spreng.

Fairly common along stream below Bhatta-Dhobighat. Also found at Katta Patthar, Jharipani etc. *Saxena* 424. Fl. & Fr. March-July.

Eupatorium riparium Regel.

Occasional along stream at Bhatta Fall (1450 m.), apparently wild. *Saxena* 1668, 1820(B). Fl. & Fr. March-April. A native of Mexico and West Indies.

Gnaphalium purpureum L.

Occasional along waysides in open or shady places. Cloud End, near Birla Niwas etc. *Saxena* 1391, 1473. Fl. & Fr. Sept.-Nov.

Laggera falcata O. Ktze.

Common on hill-sides at Rajpur especially near sal forest. *Saxena* 1435, 1581. Fl. & Fr. Oct.-Dec.

Laggera pterodonta Sch.-Bip.

Occasional in waste lands at Rajpur. Along stream in moist and somewhat sheltered places near Kutalgaon. *Saxena* 185, 1733. Fl. & Fr. Jan.-April.

Prenanthes violaefolia Dcne.

Rare in sheltered places on the way to Benog, Dhobighat, Charleville Road etc. *Saxena* 1509. Fl. & Fr. Oct.-Nov.

Wedelia wallichii Less.

Rare, in forest undergrowth at Kamptee Fall. *Saxena* 2141. Fl. & Fr. Aug.-Sept.

CAMPANULACEAE

Campanula canescens Wall. ex DC.

Occasional in open places at Bhatta Fall, Kamptee Fall etc. *Saxena* 1670. Fl. March. Fr. April-May.

Cephalostigma hirsutum Edgew.

On open grassy slopes in Murray's Spring Forest and near Bhatta Fall. *Saxena* 1384, 2556. Fl. & Fr. Sept.-Oct.

Lobelia alsinoides Lamk.

Somewhat gregarious in open moist places near sal forest, Rajpur. *Saxena* 2294. Fl. & Fr. Sept.-Nov.

Lobelia heyneana R. & S.

In moist places at Kamptee Fall. In sheltered, stony ground above Kutal village (1150 m.). *Saxena* 1541, 2231. Fl. & Fr. Sept.-Nov.

Wahlenbergia gracilis Schrad.

In somewhat moist grassy slopes in the clearings in sal forest, Rajpur. *Saxena* 1172. Fl. & Fr. March-June.

MYRSINACEAE

Ardisia solanacea Roxb.

Along shady ravines in sal forest at Rajpur. *Saxena* 1767. Fl. May-June. Fr. Feb.-April.

OLEACEAE

Jasminum multiflorum Andre.

Occasional in open places at Rajpur. *Saxena* 194, 370. Fl. Dec.-April.

APOCYNACEAE

Ichnocarpus frutescens R.Br.

Occasional at Rajpur, often in sal forest. *Saxena* 1440, 2331. Fl. Sept.-Nov.

ASCLEPIADACEAE

Cynanchum glaucum Wall.

Along wayside in open places on the way from Hathipaon to Cloud End. *Saxena* 2056. Fl. June-Aug.

Periploca calophylla Falc.

Climbing on trees in shady forest; usually in shady ravines. Kamptee Fall, Bhatta Fall, Arnigarh, Barlowganj etc. *Saxena* 1715, 1848. Fl. April-May. Fr. Cold season.

Tylophora himalaica Hook f.

Frequent in somewhat shady places at Kamptee Fall. *Saxena* 2023. Fl. July-Aug.

GENTIANACEAE

Canscora decussata R. & S.

Rare, along roadsides near sal forest, Rajpur. *Saxena* 1431. Fl. & Fr. Oct.-Nov.

Canscora diffusa R.Br.

Occasional in open places at Rajpur, ascending to 1100 m. on the Bridle Path. *Saxena* 190, 1430. Fl. & Fr. Oct.-Nov.

Hoppea dichotoma Willd.

Gregarious in open grassy places at Bhatta Fall and near sal forest, Rajpur. *Saxena* 1382, 2289. Fl. & Fr. Late Sept.-Oct.

BORAGINACEAE

Bothriospermum tenellum (Horn.) Fisch. & Mey.

Kamptee Fall, in fields in moist spots. *Saxena* 1712. Fl. March-April. Fr. April.

CONVOLVULACEAE

Ipomoea cairica (L.) Sweet.

Commonly grown for ornamental purposes and naturalized at many places at Rajpur, along waysides in thickets, over hedges etc. *Saxena* 407. Fl. Most parts of the year.

Ipomoea muricata (L.) Jacq.

Occasional along waysides, over shrubs and in thickets at Rajpur, Kutalgaon, up to 1000 m. *Saxena* 2222. Fl. Aug.-Sept. Fr. Sept.-Nov.

Volvulopsis nummularia (L.) Roberty

Rajpur, in open sunny places near sal forest. *Saxena* 2355. Fl. Sept.-Oct. Fr. Oct.-Nov.

SOLANACEAE

Cestrum parquil 'Her.

Fairly common in open waste lands, south of Mussoorie, 1500-2000 m., Jharipani, Barlowganj, near Masonic Lodge etc. Completely naturalized. *Saxena* 578. Fl. April-July (but remains flowering in most parts of the year). Fr. July.

Datura tatula L. var. **tatula.**

Occasional in waste lands at Rajpur. *Saxena* 2168. Fl. April-Aug. Fr. June-Sept.

SCROPHULARIACEAE

Antirrhinum orontium L.

Occasional along waysides in waste lands, 915-2100 m., Rajpur-Jabarkhet Road etc. *Saxena* 387, 1720. Fl. & Fr. Feb.-July.

Centranthera nepalensis D.Don.

In open grassy places near sal forest, Rajpur. *Saxena* 2319. Fl. & Fr. July-Oct.

Limpophila rugosa (Roth) Merr.

Along water ditches near sal forest, Rajpur. *Saxena* 2324. Fl. Sept.-Oct. Fr. Oct.-Nov.

Lindernia hookeri subsp. **kumaunensis** Pennell

Abundant in open grassy places near sal forest, Rajpur. *Saxena* 2315. Fl. & Fr. Sept.-Oct.

Lindernia pyxidaria All.

Somewhat gregarious in wet rice fields at Kamptee Fall. *Saxena* 2248. Fl. & Fr. Late Aug.-early Oct.

Lindernia sessiliflora (Benth.) Wettest.

Frequent in moist spots in harvested field at Kamptee Fall; occasional on moist hill-sides, 1000-1600 m.; Cloud End, Barlowganj etc. *Saxena* 1392, 1515, 2251. Fl. Aug.-Sept. Fr. Sept.-Nov.

Mella hamiltoniana (Benth.) Pennell

Rare in open grassy places near sal forest, Rajpur. *Saxena* 2312. Fl. Sept.

Scoparia dulcis L.

Common along roadsides in waste lands at Rajpur. *Saxena* 1058, 1302. Fl. July-Sept. Fr. Sept.-Nov.

Verbascum chinense Sant.

Rajpur, in stony waste lands. *Saxena* 2087. Fl. & Fr. June-Aug.

Veronica biloba L.

Kamptee (1500 m.), rare, in dry places. *Saxena* 1843. Fl. & Fr. March-April.

Veronica javanica Bl.

Rare, along stream in moist situations at Bhatta Fall. *Saxena* 604, 1816. Fl. & Fr. March-May.

LENTIBULARIACEAE

Utricularia pubescens Sm.

Rajpur, near sal forest in open marshy places among grass. *Saxena* 2327 (A). Fl. & Fr. Late Sept.-Oct.

This interesting species was hitherto known only from tropical Africa and South America and is recorded from India for the first time.

Utricularia striatula Seem

Gregarious on moist walls among mosses; Half-way-House, Charleville Road etc. Also found on steep marshy slopes in sal forest, Rajpur. *Saxena* 1734, 2196. Fl. & Fr. Aug.-Oct.

PEDALIACEAE

Martynia annua L.

Occasional, in waste lands, on refuse dumps at Rajpur. *Saxena* 1020, 1284. Fl. Aug.-Sept. Fr. Oct.

ACANTHACEAE

Lepidagathis purpuricaulis Nees.

Occasional along wayside at Katta Patthar. *Saxena* 290. Fl. Feb.-April. Fr. April-May.

Perilepta edgeworthiana (Nees) Brem.

Rajpur along Motor Road in sal forest. *Saxena* 1584, 2346. Fl. Oct.-Nov.

Phlogacanthus thyrsiflorus (Roxb.) Nees.

Rare, above Kutal Gate (1000 m.) along a field. *Saxena* 1741. Fl. Feb.-April. Fr. Late March-May.

VERBENACEAE

Clerodendrum viscosum Vent.

In waste lands at Rajpur. *Saxena* 243, 400. Fl. March-April. Fr. May-July.

Loc. name: *Karu* or *Karhu*

LABIATAE

Acrocephalus indicus (Burm. f.) O. Ktze.

Common in somewhat moist situations at Rajpur and Kamptee Fall. *Saxena* 1046, 1315, 2207. Fl. Aug.-Sept. Fr. Oct.

Ajuga macrosperma Wall. ex Benth. var. **macrosperma.**

Occasional near streams in moist and shady places at Bhatta Fall (1500 m.), Kutal village etc. *Saxena* 284, 1666, 1738, 1823 (A). Fl. Feb.-April. Fr. April-May.

Elsholtzia pilosa (Benth.) Benth.

Common along waysides in somewhat moist situation at Depot, Jabarkhet Road etc. *Saxena* 1339, 2278. Fl. Sept.-Oct. Fr. Oct.

Elsholtzia stachyodes (Link). Raizada & Saxena comb. nov.; *Hyptis stachyodes* Link, Enum. 2:106, 1822.

Along wayside in open or shady places near Polo ground, Charleville, and on the way to Murray's Spring. *Saxena* 1332, 1529. Fl. Sept.-Oct. Fr. Oct.-Nov.

Leucas mollissima Wall. var. **scaberula** **Hk.**f.

Frequent in somewhat moist and shady places near or inside sal forest, Rajpur. *Saxena* 2080. Fl. July-Aug. Fr. Aug.-Sept.

AMARANTHACEAE

Alternanthera paronychioides St. Hil.

Fairly common; carpeted along roadsides at Rajpur (950 m). *Saxena* 1968. Fl. & Fr. All the year round.

Amaranthus chlorostachys Willd.

An erect herb, about 30 cm. high. Leaves long-petiolate ovate acute or obtuse. Flowers greenish, unisexual, monoecious, in short axillary spikes. Bracts slightly exceeding the tepals. Tepals 5, unequal. Stamens 5. Styles 4, pappilose, Occasional in waste places at Barlowganj. *Saxena* 574. Fl. May-June.

The specimen quoted above was identified by van Ooststroom, Rijksherbarium, Leiden. This species is apparently new to India.

Amaranthus lividus L.

A procumbent herb; stem often pinkish. Leaves long-petiolate, ovate, ovate-oblong, rhomboid-ovate, with broadish usually deeply emarginate apex. Flowers greenish or occasionally pinkish, unisexual, monoecious, in axillary clusters or forming terminal and axillary spikes; bracts and bracteoles much shorter than the perianth. Tepals 3, exceptionally 4. Stamens 3; filaments much shorter than the perianth. Styles 2(-3) Utricle smooth or faintly rugulose when ripe, slightly exceeding the perianth.

Frequent in waste lands and often along drains at Rajpur, occasionally along stream at Bhatta-Dhobighat and Bhilaru. *Saxena* 758, 1027, 1371, 1752. Fl. & Fr. March-Oct.

The species described above is var. *ascendens* Thell. the specimen (*Saxena* 758) was also identified by van Ooststroom, Rijksherbarium, Leiden. This variety is a new record for India.

Gomphrena celosioides Mart.

Along roadsides at Rajpur (950 m.). *Saxena* 814. Fl. & Fr. all the year round.

POLYGONACEAE

Polygonum mite Schrank.

Occasional along streams at Rajpur, Arnigarh etc. *Saxena* 1606, 1988. Fl. & Fr. June-Dec.

PIPERACEAE

Piper longum L.

Occasional at Rajpur (950 m.). *Saxena* 1033. Fl. Aug.-Sept.

LORANTHACEAE

Scurrula cordifolia (Wall.) D.Don.

Occasional at Rajpur. Found on *Woodfordia fructicosa*, *Acacia catechu*, *Mangifera indica* etc. *Saxena* 2105. Fl Cold season.

Scurrula elata (Edgew.) Danser.

Frequent on *Persea duthiei*, *Ulmus pumila*, *Populus ciliata* and *Cornus macrophylla* at Municipal Garden Road. *Saxena* 731, 2051. Fl. & Fr. June-July

Scurrula pulverulenta (Wall.) G.Don.

Frequent at Rajpur (Bridle Path) ascending to 1100 m. Found on *Mallotus philippensis, Toona ciliata, Punica granatum, Lannea coromandelica* etc. *Saxena* 1451, 2175. Fl. Oct.-Dec.

Loc. name: *Banda*

EUPHORBIACEAE

Baliospermum montanum (Willd.) Muell.-Arg.

Occasional in waste grounds or along fields at Rajpur and Kutalgaon. *Saxena* 275, 412, 1740. Fl. & Fr. Mainly March-April.

Euphorbia prostrata Ait.

Frequent along waysides and drains at Rajpur, Kincraig etc. *Saxena* 388, 740. Fl. & Fr. Throughout the greater part of the year.

Sapium sebiferum Roxb.

Frequently found in sal forest, Rajpur. *Saxena* 1914. Fl. April-May.

Loc. name: *Pancchirukh, Gutel, Tarcharbi*

URTICACEAE

Elatostema ficoides Wedd.

Rare in damp, sheltered spots at Mossy Fall. *Saxena* 3073, 2163. Fl. July-Aug.

A very interesting type of anthesis in the male flowers has been noted in the field. During anthesis the anthers detach from the centre one by one with a jerk and blow out a puff of white pollen grains; the filaments now remain free and curled in the flower with intact empty anthers. Of a receptacle, it is in only one or two flowers that a single stamen shows this process of dehiscence at a time but one after the other, with an interval of a few seconds, it takes place in every stamen of every flower of a receptacle.

Elatostema surculosum Wight.

Occasional in moist and shady places, usually on steep ground; Rajpur, Bridle Path etc.

Fleurya interrupta (L.) Gaud.

Occasional in waste lands at Rajpur. *Saxena* 1291, 2313. Fl. & Fr. Sept.-Oct.

Maoutia puya Wedd.

Abundant over a considerable area on steep, shady, hill-side near Ramtirth Ashram (Rajpur). *Saxena* 2102. Fl. June-Oct. Fr. Nov.-Jan.

Parietaria debilis Forst.

Rare, in shady places; Kulri, Landour etc. *Saxena* D. D. No. 139695, 139697. Fl. & Fr. Sept.-Nov.

MORACEAE

Cudrania javanensis Trec.

Occasional at Rajpur (near sal forest, Kutal Gate etc.). *Saxena* 1723, 2347. Fl. April-June. Fr. Aug.-Nov.

Ficus hispida L.f.

Rare, at Rajpur. *Saxena* 521, 1758. Fl. & Fr. April-June.

ULMACEAE

Ulmus pumila L.

Rare, at Vincent Hill Road, Municipal Garden Road etc. *Saxena* D. D. No. 139694. Fl. Feb.-March. Fr. April-May.

SALICACEAE

Salix acmophylla Boiss.

Frequently found along water courses, Rajpur, Bhatta Fall etc. *Saxena* 1630, 1664, 1665. Fl. & Fr. March-May.

Loc. name: *Sinsaru, Ruins*

LILIACEAE

Notholirion macrophyllum Boiss.

Rare, near Bhatta Fall, 1400 m., in open stony spots. *Saxena* 1662. Fl. March.

ERIOCAULACEAE

Eriocaulon quinquangulare L.

Rajpur, abundant in open, grassy, moist places near sal forest. *Saxena* 2189. Fl. Sept.

CYPERACEAE

Cyperus compressus L.

Frequent in waste lands at Rajpur. *Saxena* 1028. Fl. Aug.-Sept.

Kyllinga monocephela Rottb.

Rajpur, common in waste ground. *Saxena* 833. Fl. July-Aug.

Kyllinga triceps Rottb.

Rajpur, occasional in open grassy places. *Saxena* 839. Fl. July-Aug.

Lipocarpa argentea R.Br.

Occasional in open, grassy, moist places near sal forest, Rajpur. *Saxena* 2190. Fl. Sept.-Oct.

GRAMINEAE

Bothriochloa pertusa A. Camus.

Common between 900-1800 m. Rajpur, Bridle Path, Bhatta Fall etc. *Saxena* 372, 560, 1016. Fl. & Fr. Feb.-Sept.

Bromus tectorum L.

Lal Tibba 2250 m. *Saxena* 642. Fl. & Fr. April-June.

Cymbopogon martinii (Roxb.) Wats.

Near Barlowganj. *Saxena* 1559. Fl. Oct.-Jan.

Cynodon dactylon Pers.

Common in waste lands along roadsides at Rajpur, Kamptee Road (1800 m.). *Saxena* 658, 1007. Fl. May-June.

Cyrtococcum patens A. Camus.

Occasional, at Rajpur (1000 m.), Mossy Fall, Municipal Garden Road etc. *Saxena* 901, 1294. Fl. & Fr. July-Oct.

Dichanthium annulatum Stapf

Common, at Rajpur, Bridle Path, Bhatta-Dhobighat, near Kincraig etc. *Saxena* 382, 526, 562, 743, 1003. Fl. & Fr. Feb.-Sept.

Echinochloa colonum Link.

In waste lands at Kamptee. *Saxena* 1189(B). Fl. Aug.-Sept.

Iseilema laxum Hack.

Above Bhatta-Dhobighat, 1700 m. *Saxena* 746. Fl. June-July.

Phalaris minor Retz.

In and along wheat fields at Bhatta, Kamptee. *Saxena* 1679, 1739. Fl. March-May.

Setaria verticillata Beauv.

Rajpur, in waste lands. *Saxena* 1066. Fl. rains.

Vulpia myros Gmel.

Occasional at Lal Tibba (2100 m.). *Saxena* 458. Fl. March-April.

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A New Species of Freshwater Fish of the Genus *Hemiramphus* Cuv. from Gorakhpur, Uttar Pradesh, India

BY

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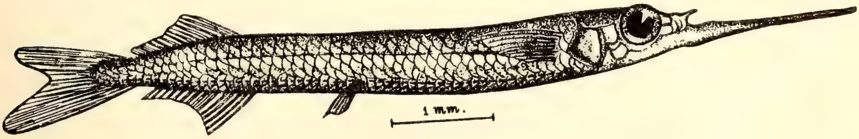
(*With a text-figure*)

INTRODUCTION

During the years 1959 to 1962, extensive collections of fish were made by me from the Gorakhpur and adjoining districts of Uttar Pradesh. The collection included nine specimens of a new Hemiramphid fish which is described here.

Hemiramphus gorakhpurensis sp. nov.

Description: D. 14-15; P. 10; V. 6; A. 15; C. 19; Ll. 50-54. Length of head is 2.53 (2.1 to 2.8), and the depth of body is 14.41 (13.00 to 15.75) in relation to standard length of the body. In relation to the length of the head the caudal peduncle is 4.65 (4.00 to 5.62), its height being 10.21 (9.33 to 11.50), interorbital space is 8.2 (7.00 to 8.5), width of head is 6.61 (5.60 to 7.60) and diameter of the eye is 7.65 (7.00 to 8.8). Eyes large and are 1.5 in relation to the postorbital length of the head, and 1 in relation to interorbital width. Upper jaw short and broadly triangular, lower jaw elongated, triangular, resembling a beak. Both jaws bear minute teeth, arranged in many rows. In the lower jaw teeth are present only on the basal portion. Dorsal fin arises slightly posterior to the anal fin. Both have concave outer margins. Base of anal fin is slightly shorter than the base of dorsal fin. The forked caudal fin has the lower lobe slightly longer and broader than the upper. 5 rows of scales between the base of dorsal fin and lateral line. Both anal and dorsal fins are slightly covered with scales at their base.



Hemiramphus gorakhpurensis sp. nov.

When fresh, the general body colour is silvery white with a brilliant silvery lateral band along the side of the body. Alcohol preserved specimens lose the coloration and the silvery band changes to black.

Holotype: In Zoological Survey of India, Calcutta, Reg. No. F. 4203/2, Maheshara Tal, Gorakhpur, Uttar Pradesh, 14th January, 1960. Standard length 78 mm. Collector: G. J. Srivastava.

Paratypes: One in Zoological Survey of India, Calcutta Reg. No. F. 4204/2, bearing the same data as holotype, standard length 79 mm. Another, bearing the same data as holotype in the Zoology Museum of University of Gorakhpur. Standard length 66 mm.

Distribution: Maheshara Tal, and River Rohini, Gorakhpur District, Uttar Pradesh.

Relationship: The new species is closely related to *Hemiramphus gaimardi* Valenciennes but can be easily distinguished from *gaimardi* by its slender body, the depth of the body being 14 times in total length whereas in *gaimardi* it is only about 11 times. *H. gaimardi* is a marine form entering estuaries and tidal rivers while *H. gorakhpurensis* is a purely freshwater species.

ACKNOWLEDGEMENTS

I am thankful to Prof. H. S. Chaudhry and Dr. A. G. K. Menon of Zoological Survey of India for assistance rendered in the study of the fish.

Studies on the Vegetation of Ponds, Swamps and River Banks in Raipur, Madhya Pradesh

BY

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(*With a map*)

The paper gives a comprehensive list of aquatic and subaquatic plants. A map of the area and climatic data of the period when observations were taken are also given. The local names and flowering period, wherever available, are also recorded.

INTRODUCTION

The study of hydrophytes has revealed very interesting facts regarding their distribution, ecology etc., in different parts of this country. The occurrence and seasonal succession of these plants are entirely dependent on the environment in which they grow. In western countries critical studies have been made on the vegetation and substrate relationships of lakes and ponds.

In India during the last decade hydrophytes have attracted the attention of a good number of workers. The work is mainly confined to the floristic composition of selected areas. The habit, habitat, flowering period, local names, ecological notes and such other features are given by different authors. Biswas and Calder (1937) were the pioneers in this field in India. They were followed by Misra (1946), Ratnam and Joshi (1952), Mirashi (1954, 1957, 1958), Pattnaik and Patnaik (1956), Sen and Chatterjee (1959), Maheswari (1960), Chavan and Sabnis (1961), Seervani (1962) and Vyas (1964). Subramanyam's " AQUATIC ANGIOSPERMS " marks a milestone in our progress towards the study of this group.

As far as the study of hydrophytes of Raipur is concerned the only work that has been done is that of Tiwari (1960). His list is incomplete because it does not include a number of plants, recorded in the present paper.

The author has made a detailed survey of the ponds, swamps and riversides of Raipur and its environs. A comprehensive list of plants present during the dry and wet phases was prepared. The habitat, flowering period and distribution were studied, brief ecological notes were prepared and wherever available the local Chhatisgarhi names are also given. A detailed ecological study of one of the tanks is in progress.

The herbarium sheets were identified, and later confirmed at the Central National Herbarium, Botanical Survey of India, Calcutta, and are deposited in the herbarium, College of Science, Raipur.

AREA OF STUDY

An area of 60 sq. km. was selected consisting of Raipur town and its surroundings, the biggest city of the Chhattisgarh region of Madhya Pradesh.

GEOGRAPHY AND CLIMATE

Raipur town is situated between 21° 10′ 25″ N and 81° 30′ 45″ E. Raipur District is remarkable for the number of ponds and tanks either natural or artificial of 1½ to 2 sq. km. area The town is at an elevation of 260 m. above sea level. The climate is very dry. Winter is the only pleasant season and it starts in November and ends by the end of February. Table I gives the rainfall and temperature data for the year 1964 during which most of the observationswere made. Compared to previous years the rainy season lasted a little longer, and there were heavy floods.

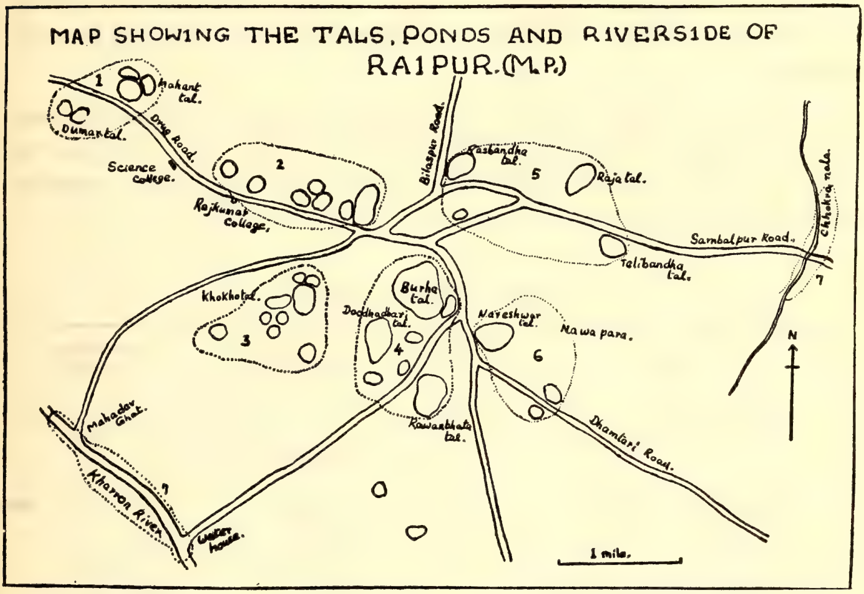
TABLE I

CLIMATIC DATA OF RAIPUR (1964)

Month	*Temp. in Degrees C.* Mean Max.	Mean Min.	Rainfall in mm.
January	28.8	14.5	Nil
February	31.2	17.4	3.2
March	36.7	22.0	0.6
April	40.6	26.0	2.1
May	42.7	28.9	0.2
June	37.3	26.7	385.7
July	30.5	23.9	392.0
August	29.6	23.7	567.2
September	31.1	24.2	154.3
October	30.9	22.3	169.6
November	28.1	15.6	Nil
December	26.9	12.3	Nil

HABITATS

Hydrophytes occupy the ponds and swamps and such habitats were studied in detail in a number of localities. The number of artificial or natural ponds and tanks, comes to 25 in and around the city. Many of them are permanent, while a few others dry up during the summer season. For convenience the total area of observation was divided into 7 smaller areas, and all these localities were visited once a fortnight and field notes were prepared. These are: (1) The Dumar tal and the neighbouring three small ponds called Mahant tal; (2) Rajkumar College area including ponds such as Karbala tal, Tharre tal, Dhobi tal, Kari tal and Ama tal; (3) Khokho tal and Bandhava tal; (4) Doodhadhari tank and surrounding area including the Burha tal, Rawan Bhata tal and other small tanks; (5) Shanti nagar area, Raja tal, Rasbandha tal and Telibandha tal; (6) Nawa Para and its surroundings including the Narhi tal and other ponds; (7) Kharron river and Chhokra nullah. The river is perennial while the Chhokra nullah almost dries up during summer.


MAP SHOWING THE TALS, PONDS AND RIVERSIDE OF RAIPUR. (M.P.)
1
Mahant tal.
Dumar tal.
Drug Road.
Science College.
2
Rajkumar College.
Bilaspur Road.
Rasbandha tal.
5
Raja tal.
Chhokra nala.
Sambalpur Road.
Telibandha tal.
7
Khokho tal.
3
Burha tal.
Doodhadhari tal.
4
Nareshwar tal.
Nawa para.
6
N
Mahadev Ghat.
Rawanbhata tal.
Dhamtari Road.
Kharron River
7
Water house.
1 mile.

The permanent and temporary ponds in all these localities support different types of vegetation. *Eleocharis plantaginea*, *Oryza rufipogon*, *Nechamandra alternifolia*, *Ottelia alismoides*, *Blyxa auberti*, *Utricularia stellaris*, *Aeschynomene indica*, *Najas minor*, and *Najas graminea*, are found generally near banks and shallow waters during all seasons, while *Limnophyton obtusifolium* is seen only after rains continuing up to summer. Deep waters show *Nymphaea stellata*, *Nymphoides cristatum*, *Nelumbo nucifera*, *Trapa bispinosa*, *Potamogeton* sp. etc. rooted in the mud and

Pistia stratiotes, *Spirodela polyrhiza*, *Lemna minor*, *Jussiaea repens*, *Hygrorhiza aristata* floating in water. When the water recedes after the rains, *Sphaeranthus indicus*, *Caesulia axillaris*, *Hygrophila polysperma*, *Asteracantha longifolia* etc. come up and are dead by summer. After the winter when water recedes further *Gnaphalium indicum*, *Volutarella divaricata*, *Grangea maderaspatana*, *Heliotropium ovalifolium*, *Coldenia procumbens*, *Wahlenbergia gracilis*, and others come up. *Aponogeton crispum*, *Hydrolea zeylanica*, *Sacciolepis myosuroides*, *Wolffia arrhiza*, *Isöetes sp.*, *Pandanus fascicularis*, *Bergia capensis*, *Aeschynomene aspera*, *Potamogeton nodosus*, *Monochoria vaginalis* etc. are present only in some localities.

On the riverside are seen *Xanthium strumarium*, *Crinum defixum*, *Canscora diffusa*, *Equisetum debile* and *Tamarix ericoides*, while from the sides of Chhokra Nullah only *Cyathocline purpurea*, *Cyperus odoratus* and *Canscora diffusa* were collected.

ENUMERATION OF SPECIES

S. No.	Species	Collection No.	Local Name	Flowering period
1.	*Nymphaea stellata* Willd.	18	Ghiri Khokhma	July to Jan. — —
2.	*Nymphaea rubra* Roxb.	194	Rathalu	Throughout the year
3.	*Nymphaea nouchali* Burm.	139	Khokhma	July to Jan.
4.	*Nelumbo nucifera* Gaertn.	17	Purain	March-June & Aug.-Nov.
5.	*Cardamine trichocarpa* Hochst.	19	—	Dec.-April
6.	*Portulaca oleracea* L.	138	Gol Bhaji	Throughout the year
7.	*Bergia capensis* L.	20	—	Aug.-Nov.
8.	*Bergia ammanioides* Roxb.	159	—	Nov.-April
9.	*Tamarix ericoides* Roftl.	191	—	Dec.-April
10.	*Corchorus aestuans* L.	26	Amoora	Sept.-Dec.
11.	*Chrozophora rottleri* A. Juss.	80	—	March-May
12.	*Sesbania aegyptiaca* Pers.	26	Dandani	Aug.-Nov.
13.	*Aeschynomene aspera* L.	24	Solhi	Aug.-Nov.
14.	*Aeschynomene indica* L.	221	—	Rainy season
15.	*Neptunia oleracea* Lour.	6	Lagoni	Sept.-April
16.	*Myriophyllum spicatum* L.	204	—	July-Dec.
17.	*Ammania baccifera* L.	29	—	Aug.-April
18.	*Ammania peploides* Spreng.	—	—	—
19.	*Jussiaea repens* L.	31	—	—
20.	*Ludwigia parviflora* Roxb.	32	—	Aug.-Oct.
21.	*Trapa bispinosa* Roxb.	30	Singhara	Sept.-Dec.
22.	*Oldenlandia corymbosa* L.	179	—	Dec.-April

S. No.	Species	Collection No.	Local Name	Flowering period
23.	*Ageratum conyzoides* L.	56	Basona	Throughout the year
24.	*Cyathocline purpurea* Kuntze	42	—	Dec.-April
25.	*Grangea maderaspatana* Poir.	33	—	Dec.-April
26.	*Sphaeranthus indicus* L.	39	Guariya	Nov.-May
27.	*Gnaphalium indicum* L.	38	Chitavar Rui	Dec.-April
28.	*Caesulia axillaris* Roxb.	36	Bilonda	Aug.-March
29.	*Xanthium strumarium* L.	37	Kothwa	Dec.-Jan.
30.	*Enhydra fluctuans* Lour.	46	Jogni Gudduru	Feb.-April
31.	*Eclipta prostrata* L.	153	Bhingra	Throughout the year
32.	*Volutarella divaricata* Benth.	57	Gukuru	Jan.-April
33.	*Wahlenbergia gracilis* DC.	168	—	Jan.-April
34.	*Exacum pedunculatum* L.	192	—	Nov.-Feb.
35.	*Erythrea roxburghii* G. Don.	163	—	Feb.-April
36.	*Canscora diffusa* Br.	61	—	Jan.-April
37.	*Nymphoides indicum* O. Kuntze	9	—	June to Sept. Jan. to March
38.	*Nymphoides cristatum* O. Kuntze	7	Jal mongra	Summer & rains
39.	*Hydrolea zeylanica* Vahl.	62	—	Nov.-Jan.
40.	*Coldenia procumbens* L.	65	—	Nov.-March
41.	*Heliotropium supinum* L.	67	—	Feb.-May
42.	*Heliotropium indicum* L.	66	—	Throughout the year
43.	*Heliotropium ovalifolium* Forsk.	63	—	Nov.-April
44.	*Ipomoea fistulosa* Mart.	150	Besharam	Throughout the year
45.	*Ipomoea aquatica* Forsk.	68	Karmatha bhaji	Oct.-Dec.
46.	*Sopubia delphinifolia* G. Don.	71	—	Rains
47.	*Dopatrium junceum* Ham.	70	—	Aug.-Oct.
48.	*Stemodia viscosa* Roxb.	195	—	Winter & Summer
49.	*Limnophila indica* Druce	69	—	Nov.-March
50.	*Utricularia stellaris* L.	73	—	Throughout the year
51.	*Utricularia exoleta* Br.	72	—	Summer
52.	*Asteracantha longifolia* Nees.	73	Mokhla	Sept.-Jan.
53.	*Hygrophila polysperma* T. Anders.	16	—	Nov.-March
54.	*Phyla nodiflora* Greene	74	—	Throughout the year
55.	*Alternanthera sessilis* Br.	76	—	Throughout the year
56.	*Alternanthera paronychioides* St. Hil.	95	—	Feb.-May
57.	*Rumex dentatus* L.	75	—	Feb.-April
58.	*Polygonum glabrum* Willd.	175	—	Jan.-May
59.	*Polygonum plebejum* R. Br.	154	—	Jan.-May

S. No.	Species	Collection No.	Local Name	Flowering period
60.	*Ceratophyllum demersum* L.	81	Beni chila	Nov.-Dec. Feb.-May
61.	*Canna indica* L.	164	—	Rains
62.	*Hydrilla verticillata* Royle	94	Gadiyari Chila	Dec.-March
63.	*Nechamandra alternifolia* Roxb.	92	Nathi Chila	Aug.-Dec.
64.	*Vallisneria spiralis* L.	11	,,	Jan.-May
65.	*Ottelia alismoides* L.	93	Juduvas	Sept.-April
66.	*Blyxa octandra* Planch.	98	Pathadi Chila	Aug.-Jan.
67.	*Blyxa auberti* Rich.	91	Nathi Chila	Aug.-March
68	*Crinum defixum* L.	211	—	Throughout the year
69.	*Monochoria vaginalis* Burm.	82	Kumha	Aug.-Oct.
70.	*Eichhornia crassipes* Solms.	83	Kumhi	Throughout the year.
71.	*Commelina benghalensis* L.	84	Kawakeni	During rains
72.	*Cyanotis axillaris* Schult.	85	Keni	Rains
73.	*Murdannia nudiflora* (L.) Brenan.	87	Ben keni	Rains
74.	*Pandanus fascicularis* Lamk.	170	Kewda	Rains
75.	*Pistia stratiotes* L.	88	Jal Kumbi (Gadh)	Oct., Dec., May, July
76.	*Colocasia antiquorum* Sch.	195	Kochii	During Summer & after rains
77.	*Spirodela polyrhiza* Seh.	89	Bhos	Seen only vegetative
78.	*Lemna minor* L.	196	Kai	,,
79.	*Wolffia arrhiza* Wimm.	197	Kai	,,
80.	*Sagittaria guayanensis* H.B.K.	80	—	Aug.-Nov.
81.	*Tenagocharis latifolia* Buchen.	97	—	After rains
82.	*Limnophyton obtusifolium* L.	8	—	Oct.-Dec.
83.	*Aponogeton crispum* Thunb.	96	—	During rains
84.	*Potamogeton crispus* L.	10	—	Feb.-April
85.	*Potamogeton nodosus* Poir.	15	Pathadi Chila	Dec.-April
86.	*Potamogeton pectinatus* L.	200	Chila	Dec.-March
87.	*Najas graminea* Del.	101	Chila	During rains
88.	*Najas minor* All.	173	Phundra chila	April-May
89.	*Cyperus cephalotes* Vahl.	108	—	Sept.-April
90.	*Cyperus platystylis* Br.	112	—	Throughout the year
91.	*Cyperus difformis* L.	141	—	Aug.-Dec.
92.	*Cyperus haspan* L.	143	—	July-Nov.
93.	*Cyperus iria* L.	144	—	During rains
94.	*Cyperus alopecuroides* Rottb.	114	—	Throughout the year
95.	*Cyperus corymbosus* Rottb.	156	—	During rains
96.	*Cyperus sanguinolentus* Vahl.	145	—	After rains

S. No.	Species	Collection No.	Local Name	Flowering period
97.	*Cyperus rotundus* L.	140	—	Sept.-Dec.
98.	*Cyperus odoratus* L.	115	—	During rains
99.	*Eleocharis plantaginea* R.Br.	210	Gangai	After rains
100.	*Eleocharis fistulosa* Schult.	105	—	July-Nov.
101.	*Fimbrystylis miliacea* Vahl.	111	—	After rains up to Dec.
102.	*Fimbrystylis tetragona* R.Br.	102	—	Jan.-May
103.	*Fimbrystylis aestivalis* Vahl.	157	—	—
104.	*Fimbrystylis diphylla* Vahl.	109	—	Rainy season
105.	*Scirpus supinus* L.	107	—	Aug.-Nov.
106.	*Scirpus articulatus* L.	116	—	During and after rains
107.	*Coix lachryma-jobi* L.	183	—	After rains
108.	*Oryza rufipogon* Griff.	119	Passer	Throughout the year
109.	*Themeda laxa* A. Camus	127	—	Rainy season
110.	*Leersia hexandra* Sw.	166	—	Sept.-Dec.
111.	*Hygrorhiza aristata* Nees.	5	Kothwa	Summer and after rains
112.	*Pseudoraphis spinescens* Vick	131	—	Aug.-Nov.
113.	*Setaria pallide-fusca* Stapf.	28	—	July-Nov.
114.	*Paspalum distichum* L.	120	—	July-Dec.
115.	*Hymenachne pseudointerrupta* Muell.	117	—	Aug.-Nov.
116.	*Panicum paludosum* Roxb.	132	—	Aug.-Dec.
117.	*Echinochloa cruspavonis* Schott.	136	—	Rainy season
118.	*Ischaemum rugosum* Salisb.	128	—	After rains
119.	*Sacciolepis myosuroides* (R.Br.) A. Camus	190	Podpoda	Throughout the year
120.	*Isöetes sampathkumaranii* Rao	220	—	Aug.-Dec.
121.	*Isöetes* sp.	100	—	Aug.-Dec.
122.	*Marsilea quadrifolia* L.	182	Chunchunia bhaji	After rains
123.	*Marsilea minuta* L.	181	—	Oct.-March
124.	*Azolla pinnata* R.Br.	99	—	Nov.-Jan.
125.	*Ceraptopteris thallictrioides* Brong.	160	—	Nov.-March
126.	*Equisetum debile* Roxb.	191	—	Oct.-Dec.

OBSERVATIONS

In the distribution, some of the plants *Monocharia vaginalis*, *Eleocharis fistulosa*, *Sagittaria guayanensis*, *Enhydra fluctuans*, *Aeschynomene aspera*, *Ipomoea aquatica*, *Isöetes* sp. etc. are confined only to one or two ponds and it is interesting that not a single plant of these could be found anywhere else in the area.

So far 126 species belonging to the aquatic and subaquatic types were collected and some of the plants coming up during the dry phase were also included. The list includes 7 plants belonging to Pteridophytes 119 Angiosperms. They belong to 87 genera and 43 families.

ACKNOWLEDGEMENTS

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Reviews

1. EVOLUTION. By Michael J. Kenny. pp. 180 (17.5×10.5 cm.). 17 text figures. London 1966. The English Universities Press Ltd. Teach Yourself Books. Price (in U.K.) 8*s*. 6*d*.

Michael J. Kenny's EVOLUTION is a good example of what a teach-yourself book ought to be. The author knows exactly what he wants to say and has the knack of making clear the meaning of what he says. In the result he gives his reader something concrete to carry away and, if he is so minded, to add to or to modify by further reading.

The author deals with the theory of evolution historically. Beginning with the earliest ideas about the origin of the variety of animal and vegetable forms, he comes by slow degrees to the joint paper read by Darwin and A. R. Wallace and the publication of THE ORIGIN OF SPECIES. After a brief account of the reception their theory received and a glance at weak points in the theory, he goes on to show how Gregor Mendel's long overlooked discovery relating to the inheritance of characters and Hugo de Vries's discovery of mutations fitted into the Darwinian theory and strengthened its weak places. A discussion of the further work done in genetics after Mendel and de Vries leads the reader gradually to the generally accepted ' synthetic ' theory of today. Having dealt with the theoretical part, the author then proceeds to set out the course of evolution as seen by the evolutionists, finishing the review with an interesting chapter on the evolution of Man which takes us up to the Olduvai Gorge discovery of *Homo habilis* in 1964.

D. E. R.

2. DICTIONARY OF ECONOMIC PLANTS IN INDIA. By P. Maheshwari and Umrao Singh. pp. 197 (14×21 cm.), New Delhi, 1965. Indian Council of Agricultural Research. Price Rs. 9.50.

The authors mention in the short preface of the book that they were entrusted with the task of preparing a Dictionary of the Economic Plants of India giving their English and Hindi names along with a brief note on their uses by the Indian Council of Agricultural Research. It is also stated that the information pertaining to Indian Economic Plants was available in a number of scattered publications dealing with many specialized aspects such as agriculture, horticulture, floriculture, forestry, drugs etc. The consolidation of this information into a single handbook for ready reference occupied almost all their spare time for more than three years. This reviewer and perhaps many other readers also are left wondering as to whom the information given in this dictionary is likely to be useful.

Persons who like to refer to such glossaries are generally looking for specific information of some significance and the specialized publications on various subjects are far more useful than such a consolidation which lacks all significant data regarding useful parts of plants. This Dictionary contains the scientific names of over 1,700 plants—validated by 3 experts—one each from the Botanical Survey, Forest Research Institute and Council of Scientific & Industrial Research. (No doubt, these names will change and go on changing); English and Hindi names (which have no standardisation); followed, as far as possible, by a brief account of the habit of the plant, *present* areas of distribution or cultivation in India and chief uses to which they are put—without any reference. In preparing this work the authors have drawn freely from a number of sources, the more important of which—only about 45—are listed in a bibliography at the end. To add to the utility of the book, indices of English and Hindi names of plants are appended.

It is apparent that this book closely follows the treatment of a similar work by J. C. Th. Uphof (New York, 1959) but is not as good. Uphof has given a much more comprehensive bibliography of about 200 titles systematically divided in about 20 groups and again arranged in 10 geographical regions of the globe and has also listed a few important journals. Comparison of a few random items e.g. *Citrus* spp., *Punica granatum*, *Salvadora persica* will bring out the value of these two comparable publications. This reviewer regretfully notes that this publication adds to the list of uncritical compilations in Economic Botany of India which have of late been proliferating. It is further regrettable to find that a scholar of the calibre of late Professor P. Maheshwari agreed to associate himself to such a non-critical publication. This is perhaps a sole exception to the most thorough and numerous publications by this great scientist. Precise and characteristic data regarding the useful items with the most important or significant references would have brought some significant reference value to this work. The present work would appear to serve the purpose of a triple index of Scientific, English and Hindi names of Economic Plants of India.

P. V. BOLE

3. MAN AND INSECTS. By L. Hugh Newman. pp. 252 (26×19 cm.). Numerous coloured and monochrome illustrations. London 1965. Aldus Books. Modern Knowledge Series. Price 45*s*.

" Only a few generations ago most people thought of insects as little more than an unavoidable nuisance; the few who collected and studied them were regarded as harmless eccentrics Today the position is vastly different. Throughout the world much time, effort, and money is willingly spent on the study of insect anatomy and physiology, the comparison of different species, the investigation of the habits of insects in nature and in the laboratory, the influence of climate and weather on their abundance and distribution, and the far-reaching problems of insect control. We are becoming more and more aware of the tremendously important part that insects play in the world of nature and in our own lives, and as a result we want to learn as much as we can about them." This passage from the closing chapter of L. Hugh Newman's MAN AND INSECTS states the purpose behind his book—to tell the general reader about the mutual relations between man and insects.

In the first section he deals with insects generally, perhaps at undue length, but the section includes some interesting material particularly the chapters on reproduction in insects, insect parasites, and how insects spread.

In section II he comes to his main theme. Beginning with insects as vectors of disease, he tells briefly the stories of malaria, plague, and sleeping sickness. Among other things he describes how the African malaria mosquito *Anopheles gambiae* suddenly appeared in Brazil and multiplied so rapidly in 8 years that in the first 6 months of the epidemic 14,000 Brazilians died; however, a determined campaign in which the whole area was divided into manageable squares each to be worked over almost yard by yard by its special team completely rid the country of the invading pest within about two years. Next he deals with insects as pests of the world's crops; locusts, as justified by the nature of their depredations and the international scale on which their menace has to be dealt with, are given a separate chapter. Among other methods of control he mentions the use of pathogen-laden sprays, and stresses the importance of finding means of control specific to the pest concerned so that harmless or useful insects may not be destroyed. It is somewhat surprising that he does not mention in this connection the use of sterilization-by-radiation technique, so successfully employed against the screw-worm in the United States as noted by the author in the last chapter of his book. Dealing with the control of weeds he describes among others the spectacular results achieved by biological control with the prickly pear in Australia. The closing chapter deals with research in that important insect, the honey bee.

Section III, From Field to Laboratory, treats of the supply of insects to laboratories, educational institutions, etc., by hunting or breeding. Very useful tips are given regarding locating, catching, and breeding. On the last of these the author speaks with special authority having inherited an insect farm from his father.

Finally, speaking of 'Insects in a Changing World' the author mentions something that is of peculiar interest to us, viz. experiments said to be in progress in India with an airtight granary. The idea is that this inflatable nylon granary, capable of holding 500 tons of wheat, will be collapsed on the stored grain and sealed, and that any insects that may be in it will die from want of oxygen.

D. E. R.

4. THE CRAB AND ITS RELATIVES. By Philip Street. pp. 167 (22×14 cm.). With 22 plates and 45 text figures. London, 1966 Faber and Faber Ltd. Price 30*s*.

While we have quite a number of popular books on the natural history of the land Arthropods such as insects and spiders, this is unfortunately not the case with the aquatic Arthropods, or Crustacea. The present book fills this lacuna. Although, to a cursory glance the book might appear to be only an enlarged version of a chapter from a standard text book of zoology, more careful study will reveal to the reader the varied aspects of life of this important group of animals in all its complexity.

Starting with a general introduction, the animals are dealt with in evolutionary order, from the lowly fairy shrimp to the highly evolved crabs. The fourth chapter—the pastures of the sea—is not quite relevant to the general theme of the book, dealing as it does almost exclusively with diatoms.

The descriptions of the anatomy and the ways of life of the animals are good but some errors are noticeable. For example *Orchestia* has been twice wrongly spelt as *Orchestria* and the statement on page 49, " it is to the swarming of diatoms in the surface layers that the sea owes its green colour," is an over-simplification.

The illustration on page 91 is not of *Asellus*, which is slender and more or less rectangular. The boat-shaped body indicates that it should be *Aega*.

On the spiny lobster *Palinurus*, it is stated on page 119, that " the crawfish lacks any pincers on any of its thoracic legs," but this is contradicted by the caption for the photograph of *Palinurus* (between pages 64 and 65), " its claws are very much smaller than those of true lobsters." The statement on page 139, that " at mating time the smaller female (crab) travels about on the back of her larger mate," is obviously wrong; it is well known that during courtship or in the pre-copulatory stage, the male crab clutches the female under him, using his legs to hold her and to prevent her escape. After she has moulted, he turns her over on her back (still under him) and copulates with her.

The author's description of crustaceans are on the whole accurate, but the habits of the octopus as a predator of Crustacea has been poorly handled. The mode of feeding of the octopus: "uses the flexible tips of its arms to extract the meat and pass it into its mouth" is adapted from the naturalist Joseph Sinel's account given in Frank W. Lane's book KINGDOM OF THE OCTOPUS. Actually the octopus enfolds its victim within the webs of its arms, probably injects a powerful poison to paralyse its prey, and the crab is then opened at the junction of carapace and abdomen. A powerful salivary secretion is also poured into the body of the crab which partially digests and liquefies much of the soft tissues. All this is well described in Lane's book, but has not been taken into account by the author.

The author's remarks on the same page, *viz.*, " the captured crab may be kept *alive* (italics by reviewer) for some time while others are collected. One octopus was observed to collect no fewer than seventeen crabs before settling down to its meal ", are also adapted from Sinel's account. It is difficult to envisage how an octopus can cope up simultaneously with so many *live* crabs and prevent their escape.

Again, the following account of an octopus's battle with lobsters, on page 116, is difficult to believe. After a day and night battle, "the keepers arrived to find the octopus sleeping peacefully surrounded by the empty shells not only of its previous day's opponent, but of those of all the other occupants of the tank as well." The size of the octopus or the number of lobsters it killed and ate is not mentioned, but it would be an over-aggressive octopus with a prodigious appetite that could manage such a feat!

Nevertheless, in spite of these errors, the book is good reading, not only for naturalists in Britain, for whom it is primarily meant, but even for those of tropical countries, as a majority of the animals described in the book are cosmopolitan in their distribution and occur on our shores.

The photographs are excellent, as are also most of the drawings. It would have been better if the artist had blacked in the eyes of *Squilla* (on page 76) and *Gammarus* (page 93), as the animals might appear eyeless to a lay observer.

B. F. C.

Miscellaneous Notes

1. PALM SQUIRREL (*FUNAMBULUS PALMARUM*, LINNAEUS) IN AUSTRALIA

Palm squirrels, *Funambulus* sp. occur only in the Oriental Zoogeographical Region. Recently *Funambulus* was reported by Abdulali (1964 *J. Bombay nat. Hist. Soc.* **61**: 495) from Port Blair, Andamans, Chaturvedi (1965, *J. Bombay nat. Hist. Soc.* **62**: 545-46) identified as *F. pennanti*, skins collected from Port Blair. Abdulali's conjecture is that they are a recent introduction to the island.

I was surprised to see the Palm Squirrel, *Funambulus palmarum* in the Taronga Park, Sydney, Australia, where they were numerous. It was amusing to watch the familiar Indian mammal in a distant country. They were mostly found on Eucalyptus trees. Their habits appeared unchanged, climbing and descending the trees, coming to the park roads for feeding, and fleeing back at speed with frantic squeaks accompanied by quick jerks of the tail.

These squirrels are also found in Perth, but entirely confined to the vicinity of the Zoological Gardens. These were introduced in the Perth Zoo early in this century and some escaped from the zoo into the surrounding garden. Some were sent to the Taronga Park Zoo, Sydney in about 1942; where a few escaped and established a colony in the Park and the immediate neighbourhood. The authorities of the Zoological gardens, Perth, made an effort under instructions from the Australian Quarantine authorities, to eradicate this rodent but a few animals still persist. It will, however, be interesting to watch the fate of these two colonies of the Indian squirrel, widely separated geographically on a distant country where they have thrived for quite sometime.

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JODHPUR.

October 14, 1966.

2. GREAT CRESTED GREBE (*PODICEPS CRISTATUS*, LINN.) IN NEPAL

I was very interested to read K. Himmatsinhji's note on the Great Crested Grebe (*Podiceps cristatus* Linn.) in Kutch in Vol. **62** (3): 551, December 1965 of the *Journal*. This year, a solitary Great Crested Grebe in full breeding plumage spent several weeks of April in the tank known as Rani Pokhari which is right in the centre of Kathmandu and surrounded by busy streets and traffic. I did not make a note of the exact dates of its stay in Kathmandu, but I drew Dr. Robert Fleming's attention to its presence here, and he was delighted to have a new record.

The Great Crested Grebe was recorded by Rand and Fleming in December and February at Pokhara in 1957 (Biswas, *J. Bombay nat. Hist. Soc.* **57**: 282). So this was the first spring record.

C/o U.N.D.P., R. G. M. WILLAN
P. O. Box 107,
KATHMANDU,
NEPAL.
September 23, 1966.

3. THE PURPLE WOOD PIGEON (*COLUMBA PUNICEA*, BLYTH) AND THE HIMALAYAN TREE PIE (*DENDROCITTA FORMOSAE* SWINHOE) IN ORISSA

Ripley's (1961) SYNOPSIS gives the range for the Purple Wood Pigeon as follows: " Assam and Pakistan, a rare vagrant to Ceylon. . . ". Biswas (1960) extended the range to S. E. Bihar and southern W. Bengal. Mooney (1934) noted it through the " forest tracts of Orissa, southwards to the borders of the Madras (Presidency)". Sálim Ali (*in litt.*) has observed them in the Simlipal Hills of Mayurbhanj between 2000 and 3000 ft. altitude, and collected a specimen from Bailadilla in Bastar District. I have recorded it nine times since 1963 now between 14 October and 24 February in the Chandka Game Sanctuary about 8 kilometres from Bhubaneswar at less than 200 ft. altitude in a clearing between paddy fields and teak forests. They were seen in flocks of up to 15 birds.

Ripley (1961) states that the Himalayan Tree Pie occurs in the " Eastern Ghats of Northern Andhra, Southern Orissa in Visakhapatnam and Koraput (Jeypore) at *c.* 3000 ft.". Sálim Ali has seen it round Berbera (Puri district) between 200 and 1000 ft. I have seen it on over 40 occasions now in the Chandka Game Sanctuary at under 200 ft. altitude, either solitary, in pairs or groups of up to 10 individuals.

I am grateful to Dr. Sálim Ali and Mr. Humayun Abdulali for contributing their observations and literature.

GENETICS AND BIOMETRY LABORATORY, S. D. JAYAKAR
GOVERNMENT OF ORISSA,
BHUBANESWAR—3,
ORISSA, INDIA.
November 16, 1966.

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4. NESTLING OF COMMON INDIAN NIGHTJAR (*CAPRIMULGUS ASIATICUS*, LATHAM)

On 19th September 1966 at about 11.30 p.m., while searching for nocturnal vertebrates, I spotted a Common Indian Nightjar (*Caprimulgus asiaticus* Latham) sitting on the ground among pebbles in a dried up nullah at Shindewadi, Poona District. I approached the bird gradually keeping it within the powerful beam of a 6-celled head-light and managed to catch it by hand. The discovery of a slightly cracked egg underneath the bird explained the reluctance on its part to fly away from the spot on my approach. Disconcerted at having broken the egg by the impact of my hand, I picked it up and was pleasantly surprised to see a nestling emerge out of the cracked shell on to the palm of my hand. I brought both the nestling and the parent back to the laboratory and kept them in a perforated wooden box till morning when they were both preserved after I had written down a description of the nestling and had photographed it. The incubating parent turned out to be the male.

A hurried glance through my reference cards and Hume's (1890: 48-99) and Baker's (1934: 488-489) accounts of the nidification of this species revealed that the nestling of this species has not been described so far. A brief description follows.

The body of the freshly hatched nestling was covered throughout with fine nestling down, 8 mm. to 12 mm. in length, dark rufous brown dorsally and light rufous brown ventrally, without any dark spots/areas on head, wings or thighs comparable to those of *Caprimulgus e. unwini* (Ticehurst 1926: 374) and *Caprimulgus mahrattensis* (Ticehurst 1926: 375). The eyes were open. The iris was warm brown. The beak was hard, greyish in colour with a black tip. The legs and claws were wheatish grey in colour. The tip of the claws were hard.The serration or comb on the third toe could be faintly made out but was soft like the rest of the claw. The nestling could sit upright, emit a weak sound and gape for food just after emergence. It could also turn over when placed on its back. It weighed *c.* 6 grams.

The Common Indian Nightjar(*Caprimulgus asiaticus*, Latham) breeds commonly around Poona. I have seen its nests with eggs as early as the middle of March and with young as late as the end of September. The nest lacks any formal attempt at construction. One or two, generally two, eggs are laid on the ground amongst pebbles or vegetation in bare dried up nullahs, hill slopes or pasture or under tree or in a patch of scrub. The eggs are elongate ovals, creamish stone to salmon pink in colour with pale reddish brown to purplish brown markings (blotches, spots and streaks etc.). On the average 21 eggs measured 26.2×19.5 mm. and weighed 5.9 grams.

ZOOLOGICAL SURVEY OF INDIA,
WESTERN REGIONAL STATION,
1182/2, F.C. ROAD,
POONA-5.
November 24, 1966.

B. S. LAMBA

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5. THE HOUSE CROW (*CORVUS SPLENDENS*, VIEILLOT) FEEDING ON THE INDIAN DESERT GERBIL (*MERIONES HURRIANAE*, JERDON)

A house crow (*Corvus splendens*) was observed on the grounds of the Central Arid Zone Research Institute (Jodhpur, Rajasthan) with a gerbil (*Meriones hurrianae*) in its beak. The crow dropped the gerbil which immediately ran off through the light ground cover. The crow, half flying and jumping, quickly caught it again and shook it several times before releasing it. The gerbil started to run off again so the crow scooped it up and flew across the road to a bare patch of ground. He shook the gerbil again and dropped it. This time because of the lack of cover and the unfamiliar territory, the crow had no trouble catching the gerbil as it started off again. This was repeated several times before the gerbil lay in place where it was dropped. The crow gave it a couple of pecks and then picked it up and flew to the top of a nearby power pole. From the slackness of the gerbil's body, it was at least unconscious if not dead. The crow then proceeded to hold it under its feet while it pecked the body apart.

The original observations indicated that the gerbil was in good condition but had apparently been caught by the crow when it was too far from its burrow. The sagacity of the crow in taking the gerbil to bare ground and its agility in recapturing it, indicates that these could be very efficient predators of gerbils if they would put their mind to the task. This is an addition to the list of avian predators of gerbils listed by Prakash (*Mammalia*, **26** (3) : 311-331, 1962).

UNESCO CONSULTANT,
C.A.Z.R.I., JODHPUR.
June 4, 1966.

WILLIAM D. FITZWATER

6. OBSERVATIONS ON THE MATING BEHAVIOUR AND COPULATION IN *DRACO DUSSUMIERI* DUM. & BIB. (REPTILIA: SAURIA)

Aspects of mating behaviour in lizard have been studied in a number of families, namely Iguanidae, Chamaeleonidae, Gekkonidae and Agamidae by a number of workers. These studies show that lizards exhibit various stereotyped patterns of display during the mating season. I have been studying the bionomics of the South Indian Flying lizard, *Draco dussumieri* from 1962. An account of the sexual dimorphism, coloration and egg-laying of this lizard has been already published (John 1962). The present communication is a brief report on the mating behaviour and copulation of this lizard based on my observations in the field for the last few years, and particularly during the months of February, March and April, 1966.

Courtship behaviour: Draco dussumieri breeds during the summer months of February, March and April in Kerala, commencing from about the middle of February and ending by end April. Courting occurs during the low temperature periods of the day, between 9.30 and 12.30 in the forenoon and 2.30 and 4.30 in the afternoon, when temperature ranges from 86° F. to 104° F. and from 104° F.-90° F. respectively. These two periods of the day are the activity periods of the lizard in the sense that they feed and mate. During the period from 12.30-2.30 p.m., the temperature may go up to 118° F. and then fall to 104° F. and during this period they rest in shade. The movements of the lizards were followed with the help of a powerful pair of binoculars. Since these lizards have territories during the breeding season, it was easy to locate and follow them.

On seeing a female, the male becomes active in its movements, and continuously folds and stretches the gular appendage. Sometimes the erected gular pouch is held directed forwards and is vibrated vigorously. At times the head is bobbed up and down with the erected gular pouch, facing the female. The colour changes to a bright silvery grey which becomes conspicuous against the dark background of the tree. In a few minutes the male glides to the palm or the branch of the tree where the female is moving about and feeding, and gradually approaches but the female may move if it is not receptive. Sometimes, when the female stops the male moves towards it and facing it, vibrates the erect gular pouch and bobs the head. With raised body and stiff tail lifted up the male crouches and slightly bending the body laterally outwards, circles around the female in a clock-wise direction moving with a characteristic jerky gait. The female remains impassive and the circling male touches the pelvic region of the female with its erected gular pouch during the second round. I have seen it repeated a dozen times within half an hour, with no response from the female. But the persuasion is continued. Normally, the culmination of this ' courtship dance ' is copulation but it depends upon the gonadial condition of the female and if the female is not in a reproductively active state, it will not submit. This is perhaps the reason why the female is indifferent towards the courting behaviour of the male during the early period of the breeding season. The male also may discontinue its courting when there is no response from the female but starts again after some time. During the courtship period the male does not feed.

Copulation: Though courting was seen every day during the breeding season, copulation was observed only twice and that too only towards the later half of the season. On 6 April, 1966 at 10.30 a m., a male and a female were seen feeding on the same tree. The day was clear after a shower on the previous evening and the ambient temperature was 96° F. The male began displaying its gular pouch and followed the female, who was reluctant in the beginning and avoided contact. During their courtship movements, they went up and down the tree several times, the male closely following the female and starting its ' dancing ' movements every time the female stopped. But when touched on the pelvic region, the female moved off. This was continued for half an hour. Finally the female turned and moved towards the male, with the rudimentary gular pouch moving indicating response. They moved a short distance touching each other, after which the male mounted and was seen biting the nape of the female, who lifted the vent and slightly tilted to one side so that the cloacas of both were brought in opposition. They remained in the position for about one minute. No thrusting movement was noticed. They then turned in opposite directions and separated. The courtship and copulation took about 30 minutes.

Reaction to other males : During the mating period, any intruding male will be chased away. The resident male will show the characteristic ' fight behaviour, ' which is similar to courtship display in its earlier stages, in that it is also characterised by head jerks and movement of the gular pouch. This is followed by unfolding and folding of the patagium, advancing forwards and retreating, and moving to one side and the other. All these displays are meant to intimidate the intruding male. But this appears to be only a threat since no fight has been actually noticed under these circumstances. This fight behaviour is a part of the " territorial response " of the male to safeguard the territorial integrity.

Discussion : Noble and Bradley (1933) observed that male displays were reserved largely for rival males and that male adornments are used in sex recognition. Studies of H. R. Bustard (1965) on *Chamaeleo hohnelii* (Steindachner) substantiated these observations. Besides, Evans (1938), Noble and Greenberg (1941) and Harris

(1964) have shown that the female lizard may take an active part in the preliminaries to mating. My observations on the mating behaviour of *Draco dussumieri* show that male displays are not directed to intruding males. Though the preliminary male displays are similar to fight behaviour in this lizard, the later ' courtship dance ' or ' parade ' around the female is quite different from the ritualized combat behaviour and is not a part of the fight behaviour. Also the female is passive and the male takes the active part in courtship.

Carpenter (1962) while making a comparative study of the display patterns of *Urosaurus, Uta* and *Streptosaurus* noted that in these lizards, courtship behaviour began similarly to the territorial defence with arching, rapid approach, circling and bobbing, but soon shifted to typical courtship behaviour which consists of rapid and shallow courtship bobs. A similar situation prevails in *Draco* also.

The prolonged curious antics, ' courtship dance ', and the excited movement of the bright yellow gular pouch and the ' head jerks ' shown by the male of *Draco* are useful in sex recognition and eliciting ' mating response ' in the female. This is really very important in *Draco* because the female is very passive. Contrary to the observations of Evans (1938), Noble and Greenberg (1941) and Harris (1964), the female takes no part in the preliminaries to mating.

Tinbergen (1953) concluded that many behavioural patterns of lower animals are psychologically primitive and involve ' social releasing mechanisms.' Evans (1938), Hunsaker (1962) and Harris (1964) investigated the releasing mechanisms in species and sex discrimination in lizards. According to Evans (1961) Iguanids and Agamids employ sight stimuli predominantly and Scincids and Geckonids generally rely on scent and sound. G. W. Ferguson (1966) investigated the relative roles of several factors which might serve as releasers of courtship and territorial behaviour in *Uta stansburiana*. In *Draco dussumieri* the elaborate ' courtship dance ' is directed to elicit mating response in the female and visual stimuli plays the vital part.

SUMMARY

1. Courtship behaviour of the South Indian Flying lizard, *Draco dussumieri* has been studied in the field. It consists of an elaborate ' courtship dance.' Female is passive and the male takes the active role in courtship.
2. On two occasions copulation was observed.
3. During the mating season male shows characteristic ' fight display' towards other males.
4. The results of the study have been discussed in the light of available literature.

ACKNOWLEDGEMENTS

I wish to express my sincere thanks to Prof. A. P. Mathew, Professor of Zoology, Mar Ivanios College, Trivandrum, for suggesting this problem and for guidance and constant help and encouragement.

MAR IVANIOS COLLEGE,
TRIVANDRUM.

K. O. JOHN

December 16, 1966.

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7. THE HOODED *MALPOLON, M. MOILENSIS* (REUSS) AND NOTES ON OTHER SNAKES OF NORTH-EASTERN ARABIA

(*With a plate*)

Corkill and Cochrane have done students of Arabian fauna a considerable service with the publication of their excellent summary of Peninsular herpetology (*J. Bombay nat. Hist. Soc.* **62** :475-506). I was specially interested in the reference to previous records of *Malpolon's* ability to produce a cobra-like hood and the question as to whether Arabian specimens exhibit this behaviour. On two occasions this year I saw *Malpolon moilensis* (Reuss) erect a hood; the demonstrations were so convincing that both times I was certain that I had finally come upon *Naja* until I had had a look at the mouths of the killed specimens and had counted scales.

My first experience with *Malpolon* was on 11 February 1966, three km. south of the Dhahran Airport in sandy country sprinkled with shrublets of *Zygophyllum coccineum.* The snake, abroad .at midday, raised his head more than a foot above the ground at my approach, dilated its neck laterally to a marked degree, and stood its ground. When

I retreated, it moved off with head still somewhat raised. The neck, while expressed as a hood, was strongly compressed dorso-ventrally. This specimen, measured later, was 39 inches long.

On 6 April 1966 we came across another specimen in the upper reaches of (Wādī) al Bāṭin at Umm ' Ushar, 120 kilometres southwest of the Qaisumah oil pumping station. This individual, also moving at midday, displayed an impressive hood and, in an effort to escape, climbed up into the engine compartment of our car from beneath. The heat soon drove it out, relieving us of the somewhat embarrassing situation of having what we then believed to be a cobra in our only vehicle. This individual was 33 inches long. *Scale count*: scale rows 17; ventrals 171; subcaudals 58.

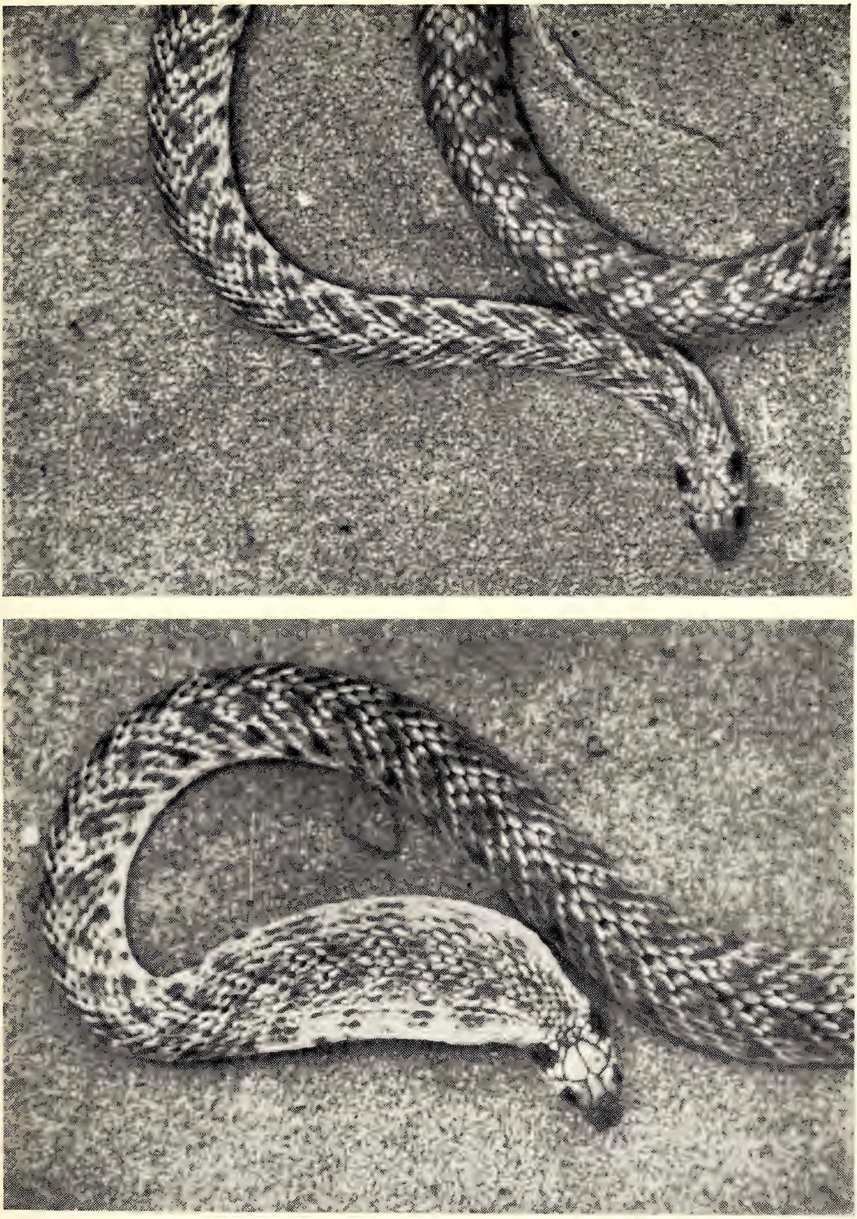
One live specimen of *M. moilensis* is now being kept by the preventive medicine unit of the Arabian American Oil Company at Dhahran. One specimen kept earlier had, in addition to the usual oblique elliptical dark mark on the neck, a second, lighter mark anterior to the main one. The Plate shows hooding behaviour in one of these individuals.

After observing *Malpolon* in the field and in captivity, I have no doubt that most, if not all, reports of *Naja* in north-eastern Arabia are based on sightings of this Colubrid. I know of no authenticated specimens of *Naja* from this area, and collection records presented by Corkill & Cochrane indicate that the distribution of *Naja* is confined to the more moist tropical parts of the Peninsula and contiguous mountain areas. I would expect that if *Naja* is to be found at all in the northeast, it will likely be in or near oasis districts.

One is tempted to view this behaviour by *Malpolon* as a case of protective behavioural mimicry, but there are serious theoretical objections. Considering it a case of classical Batesian mimicry, one must assume first of all that the hooding of *Naja* is a warning action that can be " learned " by its natural enemies. It seems, however, that these enemies, whatever they are, could hardly learn from an experience that would probably prove either fatal or entirely successful. It would also have to be demonstrated that the ranges of *Naja* and *Malpolon* do or did overlap.

To speculate further, the snakes' behaviour might be of value in conjunction with an instinctive, not learned, reaction on the part of its enemies or prey. Assume, for example, that the typical cobra attitude is not only defensive, but is effective in terrorizing its prey into immobility. A *Malpolon* could scarcely learn these tactics from a *Naja*, but may have evolved them in parallel fashion or inherited them from a common source. The behavioural pattern in both species may be only one of those evolutionary accidents for which no survival value can be demonstrated.

J. BOMBAY NAT. HIST. SOC. **64** (1)
Mandaville: *Malpolon moilensis*



Malpolon m. moilensis

Above: Live captive specimen of *Malpolon moilensis* (Reuss) with neck slightly dilated anteriorly; when completely at rest, no expansion was visible. *Below:* The same specimen, with neck almost fully dilated after gentle teasing. When more vigorously threatened, the snake hid its head beneath its coils, and the neck reverted to its normal condition. This individual, being enclosed and threatened from above, would not raise its head in the typical cobra attitude.

(*Photos: B. H. Moody*)

In any event, the similarity in behaviour may be of interest in providing a possible, if tenuous, link between the two families.

Here are some further records of snakes seen by the author in Eastern and Northern Arabia:

Lytorhynchus diadema (Duméril & Bibron), one specimen captured near the coast 66 km. NNW of Dhahran, presented by Mr. A. Valpey.

Spalerosophis diadema (Schlegel), one juvenile specimen from a garden area at Badanah Pump Station (near 31° N; 41° E), midsummer 1964.

Malpolon moilensis (Reuss), one specimen presented by Mr. W. Goellner, collected near the American Consulate, Dhahran, 22 February 1965.

Coluber ventromaculatus Gray, one collected near Al Ajām, in the oasis area of Al Qaṭīf, 3 April 1964. Length 30 inches, ventrals 210; subcaudals 90.

Cerastes cerastes (L.), common in Eastern Arabia; I collected two hornless specimens in a mixed sand-rock habitat near Dhahran.

Psammophis schokari (Forskål), one collected by me in sand-floored ravine tributary to Al Bāṭin, 30 km. WSW of Qaisumah Pump Station, 5 April 1966. Length 40 inches; tail 12 inches; scale rows 17; ventrals 166; subcaudals (damaged) 89. Entire ventral surface decidedly gray, peppered with minute darker flecks.

Eryx jayakari Boulenger, one live specimen loaned by Mr. W. Goellner, collected in the Dhahran area. This individual was docile, but finally struck in panic after being repeatedly posed for photography by electronic flash.

The Aramco preventive medicine unit presently has a collection of 28 preserved snake specimens collected over a period of about 15 years by oil company employees. Many of these lack field notes, but the following tabulation of the specimens may be of interest in indirectly suggesting the relative abundance of the species. Dr. Robert L. Peffly kindly made this collection available for study and provided data on the incidence of snake bite in the area.

Eryx jayakari	3, plus 1 live specimen
Coluber ventromaculatus ..	3 (including the specimen referred to above)
Lytorhynchus diadema	2
Malpolon moilensis	4, plus 2 live specimens
Psammophis schokari	6

Hydrophis lapemoides (Gray)? . .	6 These specimens represent the most common *Hydrophis* of the area. Previous collections have indicated *H. cyanocinctus* Daudin to be more common in these waters, but I am not able to differentiate these two similar species without comparative material.
Cerastes cerastes	4, plus 5 live specimens; of these, 3 are horned.

During the ten years beginning 1956, the Aramco medical department recorded 26 cases of snake bite; less than half of these cases were hospitalized. There were no known fatalities, and all were probably due to *Cerastes*.

J. MANDAVILLE

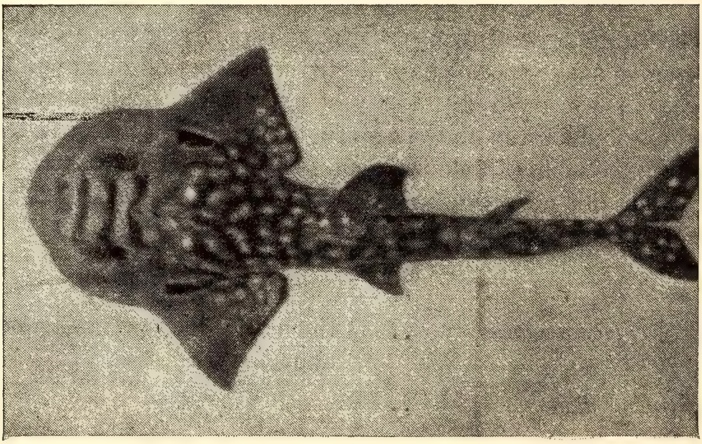
ARABIAN AFFAIRS DIVISION,
ARABIAN AMERICAN OIL COMPANY,
DHAHRAN, SAUDI ARABIA,
August 31, 1966.

8. *RHINA ANCHYLOSTOMA*, SCHNEIDER FROM THE INSHORE WATERS OFF PORTONOVO, S. INDIA

(*With a photograph*)

In September 1961, a single specimen of *Rhina anchylostoma* Schneider was caught from the inshore waters off Portonovo from the Bay of Bengal. This species has not been recorded earlier from this area.

The specimen agrees with Day's description [FISHES OF INDIA (1878)], except in the following features: The nostrils are big and elongated;



Rhina anchylostoma Schneider

spiracles are very close to the eyes; white spots are confined only to the posterior region of the body below the spiracles; there are four black bands, a semi-circular one above the eyes and three others between the eyes and spiracles.

The morpho-metric characters of the specimen are as follows:—

Total length	54.5 cm.
Maximum width	14.8 „
Height of caudal peduncle	1.5 „
Snout to first dorsal	24.0 „
Snout to second dorsal	34.2 „
Snout to caudal	44.5 „
Snout to ventral	44.5 „
Snout to hectoral	13.2 „
Length of first dorsal	3.7 „
Length of second dorsal	2.8 „
Length of ventral	3.0 „
Length of pectoral	10.0 „
Diameter of eye	2.9 „
Diameter of spiracle	1.3 „
Diameter of nostril	3.0 „
Distance between the eyes	5.6 „
Distance between the nostrils	4.5 „

The gut contents of the specimen consisted of appendages of *Squilla* sp., crabs and semi-digested organic matter.

The specimen is preserved in the Ichthyological Museum of the Marine Biological Station, Portonovo.

ACKNOWLEDGEMENTS

My thanks are due to Professor R. V. Seshaiya, Director, Marine Biological Station, Portonovo, S. India for his guidance and help, and to the Officer-in-charge, Zoological Survey of India, Patna-4 for laboratory and library facilities.

ZOOLOGICAL SURVEY OF INDIA, T. VENKATESWARLU
PATNA 16.
March 19, 1966.

9. REMARKS ON THE BAND PATTERN OF THE SOLE *ZEBRIAS SYNAPTUROIDES* (JENKINS)

(*With a plate*)

During a survey tour to the Kerala coast in 1964-65, I collected three specimens of *Z. synapturoides*, measuring 100.0-140.0 mm. in total length, at Cochin, off Vypeen Island at a depth of 16-20 metres on January 19, 1965. They differ from the typical *Z. synapturoides* in the head markings. The typical *Z. synapturoides* is characterised by nine dark transverse unbranched bands on the trunk and seven or eight bands on the head (Plate, fig. 1). My specimens show twelve dark transverse bands on the body, distributed three on the head, and nine on the trunk. Moreover among the bands on the head, the second and the third show a bifurcation giving the appearance of four bands (Plate, fig. 2). Except for the body markings they agree well in all respects with the typical *Z. synapturoides*. Examination of a larger number of specimens is required to establish races or subspecies within the species *synapturoides*.

I am thankful to Dr. A. G. K. Menon for going through the manuscript and to Shri P. K. Eapen, Deputy Director, Offshore Fishing Station, Cochin for allowing me to collect the specimens from the "Flying Fish" trawl catch.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA-16.
December 7, 1966.

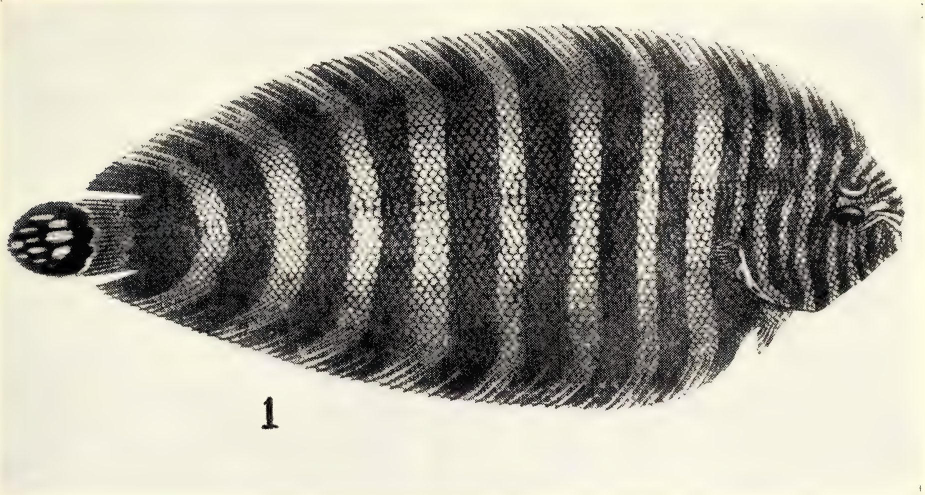
K. V. RAMA RAO

10. A RE-DESCRIPTION OF THE ANCHOVY *ENGRAULIS RAMBHAE* CHAUDHURI

Chaudhuri (1916) recorded three new species of *Thryssa* Cuvier 1829 from the Chilka lake in Orissa. He described them as of the genus *Engraulis* Cuvier. The latter name as applied to the warm water Indo-West-Pacific anchovies is incorrect, *Engraulis* being an Atlantic-Pacific genus in the New World genera of Engraulidae. Apart from other distinguishing characters (Berry 1964, Whitehead 1962), *Engraulis* lacks abdominal scutes which occur in all warm water Indo-West-Pacific engraulids, except one species of *Stolephorus*, *St. celebica* Hardenberg. Whitehead (1965) has shown that the valid generic name is *Thryssa* Cuvier 1829, and that *Thrissocles* J. & E. is the junior objective synonym, for the warm water Indo-West-Pacific anchovies.

Chaudhuri's description of the three species is based mostly on external characters and body proportions; he paid little attention to meristic characters, and totally ignored the number of gill rakers and vertebrae.

In the course of a revision of the genus, I have observed that whereas the body *profiles* are rather distinctive in most species, there is considerable overlap in many body proportions (on which earlier workers laid so much stress) of the various species, and so are of limited value in systematics. In many fishes, body proportions tend to change with age; these changes should be taken into account in systematic studies. When giving body proportions, it is also advisable to state the length range of the specimens in which the measurements were made. In *Thryssa* spp. the



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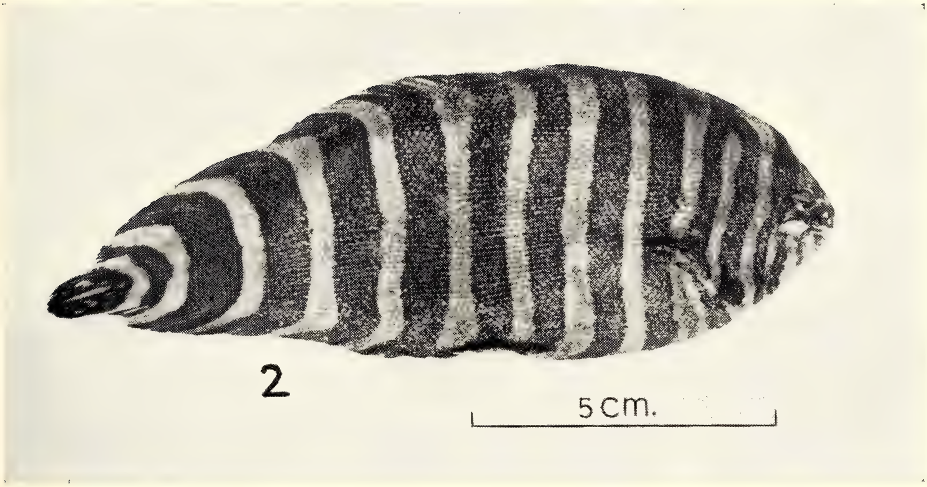

2

Fig. 1 *Zebrias synapturoides* (after Jenkins); Fig. 2. *Zebrias synapturoides* showing the band variation on the head.

limit of maxillary extension along with meristic data—particularly the number of anal fin rays, gill rakers (on the upper and lower arms of the first gill arch) and vertebrae considered together—can be effectively employed for the identification of even single specimens of any of the species.

Chaudhuri noted that in this species " the dorsal profile is highly convex and the ventral profile is almost straight "; this appears to be an artefact caused in some specimens, perhaps by preservation, for in my collection I observe that whereas in some specimens the profile is as described by Chaudhuri, in many others the back is not so arched and the ventral profile is also slightly convex.

The following re-description of *Thryssa rambhae* (Chaudhuri) is based on a re-examination of the holotype (F $\frac{8783}{1}$) in the Indian Museum, Calcutta and on a sample collected from Chilka lake on 27-9-1962.

Thryssa rambhae (Chaudhuri)

Engraulis rambhae Chaudhuri, 1916 Mem. Indian Mus., 5(4), 423-424, text fig. 5. (Rambha Bay in Chilka lake).

Description : Based on the holotype of *Engraulis rambhae*, a fish of 100 mm. total length *ex* Rambha Bay, Chilka lake (Ind. Mus. F $\frac{878}{1}$) and twenty-five specimens from the type locality, measuring 10.2-15.6 cm.

In percentages of total length and standard length[1], the latter in parentheses: body depth 23·1-24.4 (28.2-30.2), head length (snout to posterior margin of lower part of operculum, i.e. longest measurement) 16.1-17.4 (20.0-21.2), snout length 3.1-3.6 (3.9-4.5), eye diameter 3.5-4.1 (4.3-5.0), pre-dorsal distance 38.9-41.0 (48.0-50.0), pre-pelvic distance 18.2-19.9 (22.5-24.6), pre-ventral distance 31.0-33.2 (38.3-41.1), and pre-anal distance 46.0-48.0 (56.8-59.2).

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[1] The body measurements are given as percentages of both total and standard length measured to end of urostyle, because practical experience shows that in a large number of fishes, it is difficult to specify a particular and exact point at the base of the caudal fin up to which the linear measurement should be made from the tip of the snout, for ' standard length.' To take an example, Chan (1965) states that in *Sardinella* spp. he took standard length as the " distance from the tip of snout (most advanced point on median line of upper jaw) to the end of the hypural plate (this point on the base of caudal fin has been taken at the mid-point of the vertical groove formed on the skin when the fin has been bent)" (p. 105). To anyone who has handled a sardine it is clear that the point where the vertical groove appears will depend on *where* and *how* one holds the caudal fin to bend it. There is bound to be an error of one or two millimetres between measurements made by two different workers, or between two measurements of the same worker, if there is lapse of time between the two measurements. The difficulty of determining the exact *point* on the caudal peduncle for measuring standard length may not mean a serious error in large-bodied fishes, but the error may be considerable in small-sized fishes or in juveniles, or might affect the comparison of closely related species or intraspecific groups. The MANUAL OF FIELD METHODS IN FISHERIES BIOLOGY, 1960 (F.A.O., General Editor G. L. Kesteven, p. 35) lists four different points up to which standard length can be measured. Many workers do not mention which of these they have taken. This makes comparison of data of different workers difficult. No doubt a ' standard ' length is necessary in fish systematics, because in fishes, particularly those which have been subject to considerable handling or where the caudal fin rays are delicate or in old type specimens in museums, the caudal fin may not be entire, and it may not be possible to measure total length, for determining body proportions.

Snout projects only slightly beyond lower jaw. Maxillary extends almost to base of pectoral, but does not reach it. Origin of the dorsal slightly nearer to snout than to base of caudal. Anal starts before end of dorsal.

Meristic data: D 12-14, P 12-13, A 43-48, V 7, V. Sc. 14-17+9-12, G.R. 14-15+17-20, Vert. 45-47.

Colour : In freshly landed specimens, brown above, golden to silvery along the sides and silvery ventrally; venules on shoulder indistinct; dorsal and anal fins yellowish; faint grey pigment dots on the dorsal; edge of the caudal grey; pectoral and anal fins unpigmented; however, colour and pigmentation subject to variation and in *Thryssa* spp., of limited diagnostic value.

Re-examination of the holotype in the Indian Museum and analysis of the sample from Chilka lake (Table) shows that the meristic data given by Chaudhuri are not only inadequate but also partly erroneous. The number of dorsal and anal fin rays and of post-ventral scutes is in fact relatively higher than given in the original description (*vide* Table); however, Chaudhuri's text figure 5 on p. 423 does show 12 dorsal rays and 45 anal rays, both of which are in the observed range and are correct.

MERISTIC DATA OF *T. rambhae* (CHAUDHURI)

	n	D.	P.	V.	A.	V. Sc.	G. R.	Vert.
Chaudhuri ..	1	11	13	7	40	15+7	—	—
Holotype ..	1	12	13	7	45	15+9	— +17	—
Present data ..	25	12-14	12-13	7	43-48	14-17+9-12	14-15+17-20	45-47

I have not been able to obtain samples of the other two species from Chilka lake described by Chaudhuri: *T. annandalei* and *T. kempi*, but a valid description of these two species also is desirable.

ACKNOWLEDGEMENTS

I am grateful to Prof. P. N. Ganapati for excellent facilities and encouragement, and to my student Dr. M. Babu Rao who re-examined

the holotype of *T. rambhae* in the Indian Museum and also collected the sample for me at Chilka lake in 1962.

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August 16, 1965.

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11. A NOTE ON THE TORCH (*SOONTHU*) FISHING FOR WHITE-BAIT OFF RAMESWARAM IN PALK BAY

At least two species of White-Bait (genus *Anchoviella*) namely, *A. indica* and *A. commersonii* frequently occur in the fish catches from Palk Bay and the Gulf of Mannar in the vicinity of Mandapam. While adults are caught in limited quantities almost round the year in shore seines, bag nets and trawl nets, young ones of these species are caught in large numbers especially in shore seines, during March-April and September to November. Earlier records do not indicate a substantial catch of white-bait from this area, although they form a greater part of the catch in certain seasons elsewhere along the east and west coasts of India, and are highly esteemed as food fishes both in the fresh and cured condition. However, during the year 1964, the author noticed unusual catches of white-bait by torch fishing, a report on which is given in this note, along with details of this special method of fishing.

Fishing at night using lights of various types and power to attract fishes is extensively carried out in Japan, Thailand and Philippines and certain studies have been conducted on the effect of light on fish shoals, their behaviour, magnitude of the catches, etc. (Charernphol, 1951; Rasalan, 1952; Kawamoto, 1955; Nakai, 1955; Rasalan & Datingaling 1955; Takayama, 1955).

The use of torches in fishing at night in various parts of India was mentioned by Hornell (1938, 1950). According to him, torches are used in conjunction with (i) rafts specially kept to trap the leaping fishes like mullets, (ii) an ordinary sickle where large fishes are attracted by light and are slashed at and hooked out of water and (iii) spears, where any fish attracted by the blaze is immediately speared. Flying fishes are commonly caught by this method in the Laccadives. In all these cases the principle involved is the attraction of fish to light, and the torches may be made up of bundles of dried coconut leaves, dry jute stems or other cheap combustibles.

A brief reference had been made by Sekharan (1955) to torch fishing for sardines where he stated that 27 tons of fish were landed in 1½ months during 1952. Some observations on *Kelong* fishing using lights were given by Chellappa (1959). Jones (1960) referred to the remarkable attraction of the clupeoid fish, *Spratelloides delicatulus* in the Laccadive Sea near the Bitra Island when the ship's lights were switched on at night and the whole sea around became alive with millions of small, actively darting, fish on the surface. As is evident from earlier observations, while a variety of fishes may be caught by the lure of light at night, generally the method appears most effective for clupeoid fishes, *Anchoviella* being yet another example of this group.

Torch fishing, using what is known as *Soonthu* (=torch) in Tamil in conjunction with *Thattu* (=hand scoop-net) from a canoe, is one of the simplest, indigenous methods of fishing carried out in this region at night, particularly a week before and a week after the new moon. The habit of young fishes to gather around light is exploited in this method, clupeoids including *Sardinella* and *Anchoviella* species being the most common species caught.

The *Soonthu* consists of a bundle of dry palmyra leaves fastened together by a dry coconut leaf. Each bundle is about 8 ft. in length. The *thattu* or hand scoop-net consists of a circular wooden frame, 125 cm. in diameter, to which a piece of cotton net with 1 cm. mesh (knot to knot) is attached. Each fishing unit has a crew of 7 or 8 persons, 6 or 7 torches, and a few hand scoop-nets. The number of units engaged in this method of fishing is 30 but the actual number on each day of fishing may vary. The boats go out for fishing at about 7 p.m. The fishing grounds are located between one to two miles away from the shore, at depths varying from 4 to 6 metres. The fish shoals are first detected and then only the torches are ignited in succession to give continuous illumination. On lighting, fish in the vicinity are attracted and are said to come up to the surface around each boat, and are immediately scooped into the boats. The operation lasts for nearly four hours and the boats return by midnight.

During the four days 10th to 13th August 1964, each boat landed an average of 250 kg. of fish per day, the total catch weighed about 8 metric tons, and when sun-dried was valued at about ten thousand rupees. The following 15 days were moonlit nights and *Soonthu* fishing remained suspended, as fish cannot be attracted as on dark nights. Fishing was carried out on 26th and 27th August and 3rd and 9th September but catches were poor. It was reported that such large catches were not obtained the previous year and have also not been recorded in 1965 and 1966. The catches were almost purely of white-bait, consisting of *Anchoviella indica* and *A. commersonii* ranging in size from 5 to 8 cm. and 4.5 to 7 cm. respectively in total length. A few stray specimens of *Sardinella gibbosa,* 10 cm. in total length, were also caught.

The fish caught at night are immediately spread on the beach and are allowed to dry in sun up to about 3 p.m. the next day by which time they are completely dry. They are then packed in baskets made of palmyra leaf mats and exported by rail to the interior. Local price of sun-dried fish is about Rs. 1,270 per metric ton.

Soonthu fishing is carried out at Rameswaram usually between April and September by fishermen of the villages of Vadagadu, Pillaikulam, Narikuzhi and Aryankundu, situated between Thangachimadam and Rameswaram along the Palk Bay coast.

In this connection, the following observations are noteworthy from the fisheries point of view:

1. Torch (*Soonthu*) fishing for white-bait in the area appears more successful when compared to other methods.
2. Possibility of obtaining very good catches of white-bait by this method in certain seasons is indicated.
3. Night fishing grounds for white-bait are usually located off Rameswaram.
4. Young ones (4.5 to 8 cm. in length) of two species of white-bait, *A. indica* and *A. commersonii* contributed to the catches in 1964.

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12. *LYMANTRIA OBFUSCATA*, WLK. AND ITS NATURAL ENEMIES IN KASHMIR

Lymantria obfuscata Walker (Lymantridae: Lepidoptera) was recorded from all parts of Kashmir in 1963 on Willows (*Salix* spp.), Poplars (*Populus* spp.) and very occasionally on Apple (*Pyrus malus* L.), Walnut (*Juglans regia* L.), Quince (*Cydonia vulgaris* Pers.) and False Acacia (*Pseud-acacia* L.). The infestation though insignificant, caused some slight damage to Willows.

Hibernating eggs of the previous season hatched on 8 April both in the laboratory and fields at a maximum temperature of 14° C. and 75% R. H. Hatching was synchronous with the appearance of first foliage and permanent rise in temperature. The pest was active from April to mid-July when it hibernated as egg. Larval and pupal periods occupy 40 to 45 days and 10 to 15 days respectively. Of the alternate food plants tried the caterpillars fed on leaves of Apple (*P. malus* L.), Peach (*Prunus persica* Stokes), Apricot (*Prunus armenia* L.) and Cherry (*Prunus cerasus* L.) in order of preference.

NATURAL ENEMIES

I. *Diseases*

10% of the caterpillars in field and 25% in the laboratory succumbed in May to diseases caused by the following, of which the last two are potential insect pathogens.

Bacillus sp. (non-crystal forming), *Alcaligens* sp., *Brevibactor* sp. and *Acromonos* sp.

Rain and cloudy weather persistent during that period propagated the infection which receded or even disappeared on the onset of warmer days. The symptoms of the infection are:

(i) Liquefication of body of the caterpillar; (ii) blackening of cuticle; (iii) characteristic foul smell; (iv) fluid oozing from body; (v) hanging of caterpillars by first and second pairs of prolegs and (vi) brittling of body.

II. *Predators*

(1) **Calosoma himalayanam** Gestro. (Carabidae: Coleoptera).

Adults and grubs were collected from Shivpore, Pazalpore, Narrabal and Nishat by first week of June on trees and under bark, trash, ceilings and soil near tree bases.

Life history and breeding: A wide mouthed 6 lb. glass jar filled with 4 inches of moist soil is ideal for breeding 1-2 pairs of beetles. The mouth is covered with brass wire-netting, in the centre of which is attached a 1″ wide wire-gauze touching the soil. This facilitates climbing of the beetles in search of hosts that rest on top. Females immediately after copulation lay eggs in lower strata of soil at the rate of

10-15 per day averaging a total of 60. Eggs are creamy white, shining, oval with slight depression on one side. They are removed daily and placed in a separate vial, two-thirds filled with moist soil. On hatching the grubs are fed on the host caterpillars. A full grown grub measures 35-40 mm. in length; black on dorsal side and white on ventral side. There are also red patches on the ventral side. The egg, larval and pupal periods vary from 3-6, 32-36 and 10-15 days respectively. Pupae are transferred to a jar containing moist soil till the emergence of adults. A single grub consumes 30-35 caterpillars and/or pupae by feeding on their body fluids and contents. An adult beetle is 25-30 mm. long, 10-15 mm. broad and shining metallic blue. The elytra are ridged and bear minute circular depressions in rows.

(2) **Carabid Beetle** (unidentified)

Smaller in size, blacker and dull in colour in comparison to *C. himalayanam.* Collected from Shivpore and Pahalgam. The beetle was bred in the laboratory as described under *C. himalayanam.* Life history not studied.

III. *Parasites*

(a) Larval parasites

Drino inconspicuoides Bar. (Tachanidae: Diptera). Caused 40-50% mortality of the pest caterpillars in fields during June. It was recovered from the material collected from Parimpore, Shalteng, Narrabal, Shivpore, Pantachuk, Zewan, Athwajan and Pazalpore.

Life history and breeding: Adults readily mate in a cage (1′×1′×1′) having three sides and top of muslin, a sliding glass front and wooden bottom which is covered with a wet sponge. A sleeve is also attached to one side, especially when there is bright sunlight and the males are older than females. Males are usually darker in colour and bear less hairs at the tip of the abdomen. Mating lasts from 15 minutes to 4 hours. Mated females are introduced in a similar but smaller cage (4.5″×4.5″×3.2″) for completion of gestation period (about 2 days). Later they are transferred to 3″×1″ vials for ovipositing on the host caterpillars of 3-4 instars which are preferred. It was observed that active movements of the caterpillar stimulate the fly to oviposit. Under laboratory conditions unlimited eggs are invariably laid on the host but for best results not more than 3 eggs should be allowed on a single individual. The parasitised caterpillars are fed on host leaves in a jar till they pupate. The puparia are kept in an emergence box for emergence of adults. The egg, larval and pupal periods are 2-3, 10-12 and 7-10 days respectively.

The fly has a life span of about 20 days. A single female has a capacity of laying 40-60 eggs. 50-80% parasitism was obtained in the laboratory.

(3) **Exorista rossica** Mesnil (Tachanidae: Diptera)

Active from June to mid-July. Recovered from caterpillars collected at places mentioned for *Drino*. On dissection each mated female was observed to have on an average 100 eggs.

(4) **Sarcophaga** sp. (Tachanidae : Diptera)

Recovered from material collected at Parimpore, Pantachuk, Zewan and Athwajan. Parasitism in fields, negligible.

(5) **Apanteles porthetriae** Mues. (Braconidae : Hymenoptera)

Parasite cocoons collected from Pantachuk, Parimpore, Shalteng and Zanakoot from May to June. The usual site of cocoons is in crevices or under bark and very rarely on leaves. Parasitism in fields, negligible.

(6) **Apanteles** sp. near **solitarius** Ratz. (Braconidae : Hymenoptera)

Same as in the case of *A. porthetriae*.

(*b*) Pupal Parasites

(1) **Sarcophaga** sp. (Tachanidae : Diptera) was recovered from 10 to 15 per cent of the pupae collected from different parts of the valley.

(2) **Theronia** sp. or spp. (Ichneumonidae : Hymenoptera)

10 to 20 per cent of the pupae collected from Parimpore, Shalteng, Zanakoot, Pantachuk and Zewan were parasitised by *Theronia*.

(3) **Pimpla** sp. (Ichneumonidae : Hymenoptera)

Recovered from pupae collected from places as in the case of *Theronia* up to the extent of 10 per cent.

(4) **Brachymeria euploeae** Westw. (Chalcididae : Hymenoptera)

Percentage of parasitism in field, 10 to 15. Appeared in fields from mid-June.

(5) **Brachymeria** sp. (Chalcididae : Hymenoptera)

Active from late June. Parasitism negligible.

(*c*) Egg Parasites

(1) **Anastatus** sp. (?) **kashmirensis** Mathur (Eupelmidae : Hymenoptera)

(2) **Anastatus** sp. (Eupelmidae : Hymenoptera)

(*d*) Hyperparasites.

A large number of them (unidentified) were reared from puparia of *E. rossica.*

ACKNOWLEDGEMENTS

Thanks are due to Dr. V. P. Rao, Entomologist-in-Charge for providing facilities, going through the manuscript and getting the insect specimens identified by various agencies and individuals to whom also I am greatly indebted.

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September 6, 1966.

13. A RECORD OF *DELIAS SANACA PERSPICUA* FRUHSTORFER (LEPIDOPTERA : PIERIDAE) FROM INDIA

Fruhstorfer (1910) described *Delias sanaca perspicua* from females collected in Upper Burma. Subsequently the male was also described from the same locality by Jordan (1925), Evans (1932), and Talbot (1937, 1939). It has not so far been recorded elsewhere and its occurrence in NEFA is, therefore, of interest.

The Indian specimens do not exhibit any marked variations from those from Burma.

Material examined, 6 examples as follows : NEFA, Kameng, Dirang Dzong (1830 m.), 14 . x . 1961 (4 exs.); Jumla Pass (2848 m.), 17 . ix . 1961 (1 ex.); Dirang Dzong (1601 m.), 19 . vii . 1961 (1 ex.) (all S. Biswas Coll.).

ACKNOWLEDGEMENT

The authors are grateful to the Director, Zoological Survey of India, for permission to examine the material.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA.

D. K. MANDAL
H. C. GHOSH

November 18, 1966.

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———— (1939): Fauna of British India, London, **1**: 333-334, Fig. 122

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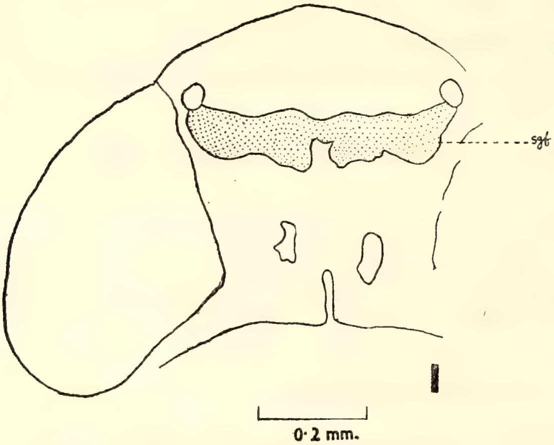
14. A NOTE ON *ARYA RUBROLINEATA* DIST. (JASSIDAE, HOMOPTERA) FROM KALYANI

(*With a text-figure*)

While examining some examples of Jassidae submitted by Shri A. K. Bhattacharya of Kalyani University, Kalyani, for identification, the author came across a few specimens of *Arya rubrolineata* Distant which had a continuous sanguineous fascia on the head. While describing the species [Distant (1908) : THE FAUNA OF BRITISH INDIA, Rhynchota vol. **4** : 338] noted the presence on the vertex of a sanguineous fascia " which is medially interrupted." The author had the opportunity of examining five males, two of which did not have a median interruption as shown by Distant, the fascia being continuous throughout (See text-figure). Two other specimens also were continuous except for a very faint interruption of the fascia at the posterior margin. The remaining specimen conformed to Distant's description.



Vertex : Dorsal View
sgf:—Sanguineous fascia

Seven other examples of the species, of both the sexes, were examined. The median interruption in them differed from specimens deposited in the collections of the Zoological Survey of India, in having a very narrow interruption, thereby showing the gradual stages of union.

The Genitalia of both varieties of the species, *i.e.* the one with the median interruption and the other without it, were examined and only slight difference in the structure of parameres was observed.

All the specimens are deposited in the National Collection of Zoological Survey of India, Calcutta.

Locality : Kalyani, Calcutta, Coll. A. K. Bhattacharya.

ZOOLOGICAL SURVEY OF INDIA, K. RAMACHANDRA RAO
CALCUTTA.
June 30, 1966.

15. RECORD OF *CLETUS BIPUNCTATUS* WESTW. (HEMIPTERA: COREIDAE) ON WILD RAJGIRA, *AMARANTHUS VIRIDIS* LINN. IN THE TARAI, UTTAR PRADESH

Wild rajgira, *Amaranthus viridis* Linn. grows wild in the campus and also around the premises of the University. It is an erect branching herb with ovate leaves. Its flowers are short-stalked with three sepals and three stamens. Its leaves and delicate stems are used as a green vegetable.

So far no insect pest of wild rajgira, *A. viridis* Linn. has been reported (Beeson 1941, Fletcher 1920, and Sen-Gupta *et al* 1957). However, a leaf-footed bug, *Cletus bipunctatus* Westwood (Hemiptera : Coreidae) causes damage to wild rajgira, *Amaranthus viridis* Linn. in Tarai area. The adult bug sucks up the plant juices of the host and may cause defoliation. The bug also sucks up the juices on the inflorescence and causes minor damage. According to Lefroy (1909), five species of *Cletus* are found in the plains and none are injurious. *C. bipunctatus* Westwood appears to be the most common.

Cletus bipunctatus Westwood measures 9.0 mm. in length and is dark brown in colour. Antennae 4-segmented, long, first segment thicker than second and third; fourth segment slightly swollen and darker than others; thorax broad with lateral pronotal angles which are distinctly seen with the naked eye; head, thorax and abdomen pale yellowish; antennae and wings brown.

The male and female are more or less alike and were seen mating in August and September on the host plant in this locality.

ACKNOWLEDGEMENTS

The author is thankful to Dr. N. K. Anant Rao, Dean, College of Agriculture, U.P. Agricultural University, Pantnagar for his interest in the work and to Dr. P. N. Chatterjee, Forest Entomologist, F.R.I. and Colleges, Dehradun, for kindly identifying the adult bug.

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16. PEDUNCULATE CIRRIPEDES, *CONCHODERMA VIRGATUM* (SPENGLER) ATTACHED TO A PENNELLID COPEPOD, *PENNELLA* SP. PARASITIC ON A FLYING FISH, *CYPSILURUS* (*HIRUNDICHTHYS*) *SPECULIGER* (CUV. ET VAL.)

(*With two photographs*)

During the 35th cruise of the U.S.S.R. Research Vessel " Vityaz " in the eastern sector of the Indian Ocean in which one of us (A.D.) participated, a flying fish, *Cypsilurus* (*Hirundichthys*) *speculiger* (Cuv. et Val.) was captured at Station No. 5173 (Lat. 13° 32′ 4″ S., Long. 105° 04′ 3″ E.) on 19-7-1962. On examination of the fish, a parasitic copepod, *Pennella* sp. was found attached to the abdominal region (Photo 1).

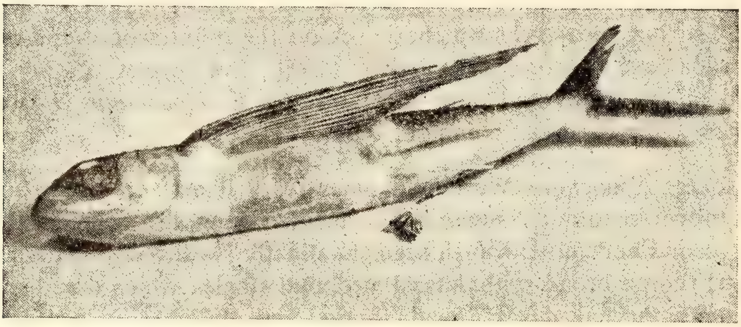


Photo 1

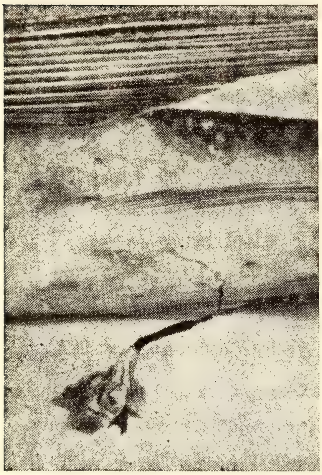


Photo 2

Three specimens of pedunculate cirripede, *Conchoderma virgatum* (Spengler) were also in turn found attached to the parasitic copepod (Photo 2). There appears to be no published account of this type of tripartite animal relationship between a flying fish, parasitic copepod and pedunculate cirripedes. Hence it is considered worthwhile to photograph *in situ* and record this interesting relationship between different forms of life.

The flying fish was obtained in a ring trawl. The parasitic copepod is directly embedded into the body of the fish and conveniently draws its nourishment from the fish. The cirripedes are attached to the fish indirectly by means of an intermediate copepod and are greatly aided by the movement of the fish resulting in wider scope in the procurement of their food by the thoracic cirri.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA.
October 29, 1966.

A. DANIEL
V. K. PREM-KUMAR

17. *EUCLIDIUM TENUISSIMUM* (PALLAS) FEDT. AND *MEDICAGO RUGOSA* DESCR.: TWO NEW RECORDS FOR INDIA

(*With a plate*)

During a floristic survey of Bashahr Himalayas, the author collected a species of *Euclidium* (Cruciferae) growing as a weed in wheat fields which was later identified as *E. tataricum* DC.

The genus *Euclidium* has two species, of which only *E. syriacum* R. Br. has been reported from India earlier. Examination of the material in Dehradun (DD) revealed a specimen of *E. tataricum* (*E. tenuissimum*) collected by R. N. Parker in 1928 from Bashahr. There is no Indian specimen of this plant in the Central National Herbarium, Calcutta (CAL.). The plant is a native of Europe and has been reported from Afghanistan and Baluchistan.

Euclidium tenuissimum (Pallas) Fedtschenko in Bull. Herb. Boiss. Ser. 2, 4: 915, 1904. *Vella tenuissima* Pallas Reise 3 : 521, 1776.

Annual erect herbs; branches many, hispid. Leaves linear, deciduous. Racemes lateral, sub-capitate. Flowers white, minute. Sepals oblong, erect, acute, imbricate, deciduous. Petals almost equalling or shorter than sepals, equal, caducuous, oblanceolate, unguiculate, limb elliptic, almost erect, retuse or truncate. Stamens 2 + 4, all nearly equal, anther 2-celled, sub-globose, base cordate. Ovary bilocular, 2-seeded, indehiscent. Seeds elliptic or suborbicular, emarginate, compressed, pendulous. *Material examined*—Chini (Bashahr) 3000 m. *R. N. Parker* 2919, May 1928, (DD). Sarahan 2400 m. *N. C. Nair* 21908 May 1962 (BSD). Kalpa 2775 m. *N. C. Nair* 22300 A, B, June 1962 (BSD).

A species of *Medicago* collected by me from Ferozpore, Punjab proved to be *M. rugosa* Descr. (Plate). It is distinguished easily by its pod. This taxon is a new record for India and is described here.

Medicago rugosa Descr. in Lamk. Encycl. 3 : 362, 1796. *M. elegans* Jacq. ex Willd. Sp. Pl. 3 : 1408, 1802; Boiss. Fl. Orient. 2 : 98, 1872.

Annual herbs. Branches prostrate or ascending 15 to 30 cm. long, pubescent and glandular. Leaflets obovate or rhomboid, pubescent on the lower surface, toothed on the upper half. Stipules lanceolate, dentate to laciniate. Peduncle 1 to 4-flowered, shorter than the leaf. Calyx teeth equal to the tube. Corolla yellow, glabrous. Legume discoid, dextrose, glabrous or slightly pubescent, coiled twice or thrice with thick flat coils markedly rugose along the margin and transverse reticulate nerves.

The plant has been reported from France, Italy, Greece, Asia Minor, N. Africa, Malta.

Material examined—N. C. Nair 36373 A, B.

Collected on March 14, 1966—deposited in BSD.

BOTANICAL SURVEY OF INDIA,
76, ACHARYA JAGADISH BOSE ROAD,
CALCUTTA-14.

N. C. NAIR

September 30, 1966.

18. *AMARANTHUS POLYGONOIDES* LINN. FROM OSMANABAD DISTRICT : A NEW RECORD FOR INDIA

Amaranthus polygonoides Linn. Amoen. Acad. 4: 409, 1760.

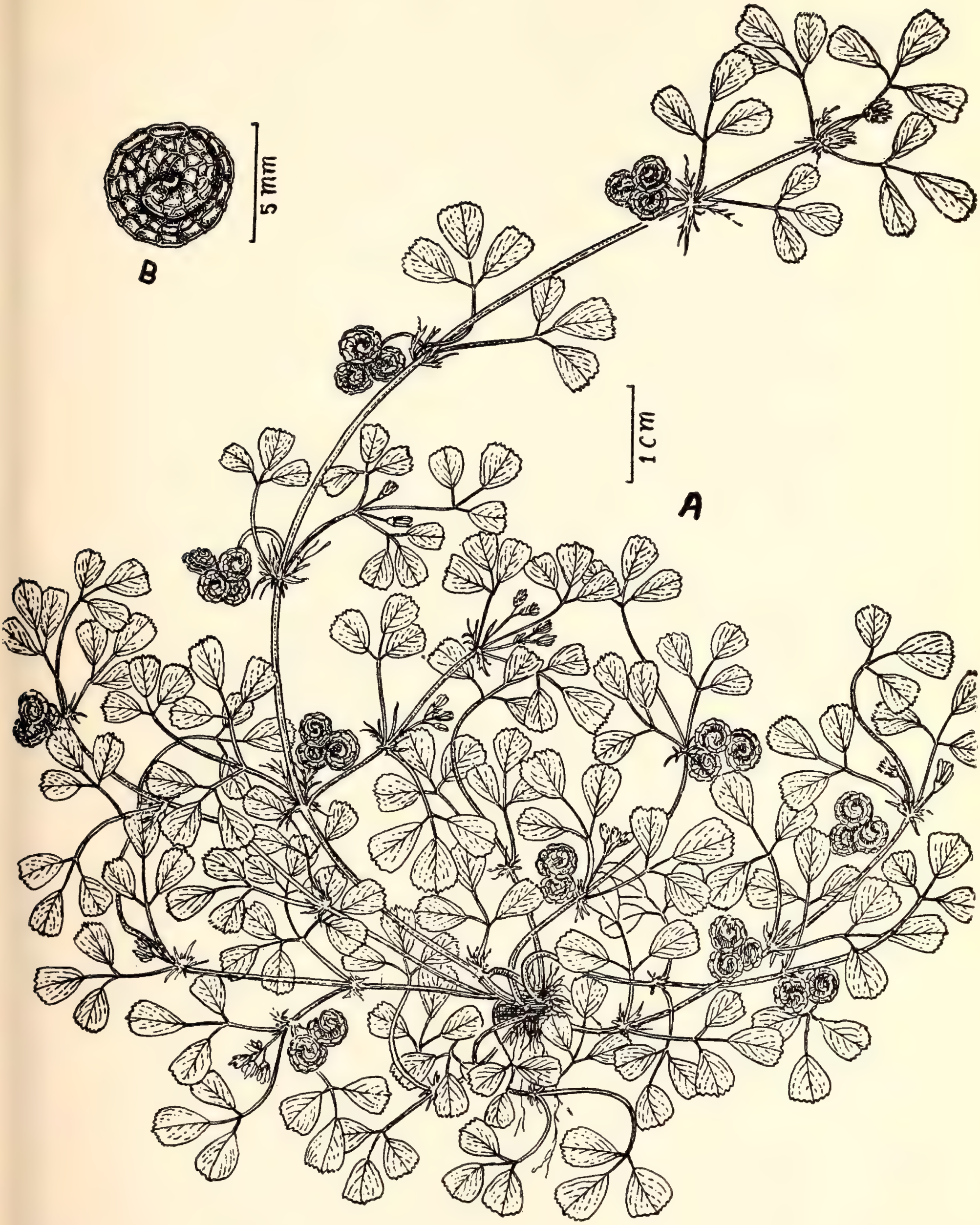
Herbs 15-40 cm. tall, sparingly branched. Stem grooved, pubescent. Leaves lanceolate to rhomboid, narrowed at base, tapering into 0.5-2 cm. long petiole, 1-3 × 0.5-1.5 cm., acute with a small mucro at apex, prominently nerved, glabrous. Flowers unisexual, pale green, clustered in leaf axils. Bracteoles subulate or lanceolate, cuspidate, about 1 mm. long. Tepals 5, oblong or oblanceolate, cuspidate at apex, 2 × 0.5-0.7 mm. Stamens 5, as long as or slightly shorter than tepals. Ovary dome shaped with 3 persistent styles. Ripe utricle faintly rugulose. Seed orbicular or obovate, shining brown or black.

The plant is very common in the district and grows gregariously on waste land along roadsides and on old walls. Naldurg fort, *Naik* 299; Paranda Fort, *Naik* 717; Turori, *Naik* 1139.

Flowers and fruits:- August to October.

According to Trimen (A HANDBOOK TO THE FLORA OF CEYLON, Pt. III, p. 398, 1895), the plant is distributed throughout the tropics but it has not been recorded in any of the Indian Floras and in the Floras of other Tropical countries. Trimen described *A. polygamus* (Hooker, FLORA BRITISH INDIA 4:721), under this name.

Nair: *Medicago rugosa*



Medicago rugosa Descr.

A. Entire plant. B. Pod.

ACKNOWLEDGEMENTS

My grateful thanks are due to the Director, Royal Botanic Gardens. Kew, England, for identification of the plant, and to the Director, Botanical Survey of India, Calcutta, for use of the herbarium and library at Sibpore.

RAMKRISHNA MAHAVIDYALAYA, V. N. NAIK
OSMANABAD.

August 18, 1966.

19. *JUSTICIA TRINERVIA* VAHL.: A NEW RECORD FOR ORISSA

This species was collected recently from the Panchagarh R.F., Puri District, Orissa. It has not been recorded earlier from Orissa.

Justicia trinervia along with *J. betonica* Linn. and *J. nilgherrensis* Wall. forms a compact group easily recognizable from other species of *Justicia* in having white bracts and bracteoles with green nerves.

Justicia trinervia Vahl. Enum. 1 : 156, 1804; Clarke in Fl. Brit. Ind. 4 : 526, 1885; Gamble, Fl. Press. Madr. 755, 1956 (Repr. ed.). *Adhatoda trinervia* (Vahl.) Nees in Wall. Pl. As. Rar 3: 103, 1832 and in DC. Prodr. 9 : 386, 1847. *A. variegata* Nees in DC. Prodr. 9: 385, 1847. *Nicoteba trinervia* (Vahl.) Lindau in Bot. Jahrb. 18 : 56, 1894 and in Engl. & Prantl. Pflanzenfamilien 4(3B): 329, 1895.

Specimens examined: Panchagarh R. F., Puri District, Orissa. *Sreemadhavan* 1275 (CAL.).

World distribution: India and Nile area in Ethiopia.

BOTANICAL SURVEY OF INDIA, C. P. SREEMADHAVAN
76, ACHARYA JAGDISH BOSE ROAD,
CALCUTTA-14.

October 18, 1966.

20. *ELATINE AMBIGUA* WT.: A NEW RECORD FOR ERSTWHILE BOMBAY STATE

(*With a plate*)

Elatine ambigua Wt. in Hook. Bot. Misc. 2 : 103, Suppl. t. 5, 1831; Dyer, in Fl. Brit. India 1 : 251, 1874; Gamble, Fl. Madras 1 : 49, 1958 (repr. edit.); Baker in Fl. Males. I, 4(3) : 206, 1951.

Creeping *herbs;* stem and branches glabrous, branches radially spreading. *Leaves* 2-7 × 0.5-2 mm., opposite, glabrous, elliptic-oblong, entire, subacute or obtuse at apex, narrowed at base, penninerved with distant glands along the margins; stipules ± 1 mm. long, ovate triangular, acute, entire. *Flower* axillary, solitary. Peduncle 1-2 mm. long, glabrous. *Sepals* 3, ± 1 mm., oblong, slightly connate at base. *Petals* 3, 1.5 × 1 mm., ovate-oblong, pinkish. *Stamens* 3. *Ovary* glabrous, 3-loculate, with three sessile stigmas. *Capsule* ± 1 mm. across, subglobose, glabrous, faintly three-lobed. *Seeds* many, brown, oblong or slightly falcate, with scalariform reticulation.

Rare, a small patch in moist ground along margins of a pond near Tuwa Station in Panchmahal District, Gujarat (*Deshpande* 952). The plant, so far, has not been reported earlier from the former Bombay State.

The authors are grateful to Dr. R. C. Bakhuizen van der Brink Jr. of Rijksherbarium, Leiden, Netherlands for confirming the identification.

DEPARTMENT OF BOTANY,
SARDAR PATEL UNIVERSITY,
VALLABH VIDYANAGAR,
DIST. KAIRA, GUJARAT.

J. G. CHOHAN
G. L. SHAH
M. B. DESHPANDE

November 18, 1966.

21. ADDITIONS TO THE FLORA OF DANGS FOREST, GUJARAT

The flora of different areas of Dangs forest is better known through the works of Santapau (1954-55), Jain (1963) and Santapau & Shah (1965). During intensive exploration in different areas in the vicinity of Ahwa, Subir, Malegam and Saputara, the authors collected about one hundred more plants, which, so far, have not been reported from Dangs forest by other workers. As the information about most of the monsoon plants and particularly the ephemeral flora is not much, it is thought worthwhile to account for the monocotyledons only in this paper. The enumeration is a supplement to the list given by Santapau (1954-55), Santapau & Kapadia (1959-63) and Santapau & Shah (1965).

The plants marked with an asterisk are not given by Cooke. For the sake of brevity only our collection numbers and localities for each plant are given. The herbarium sheets are deposited in the Botany Department of this University.

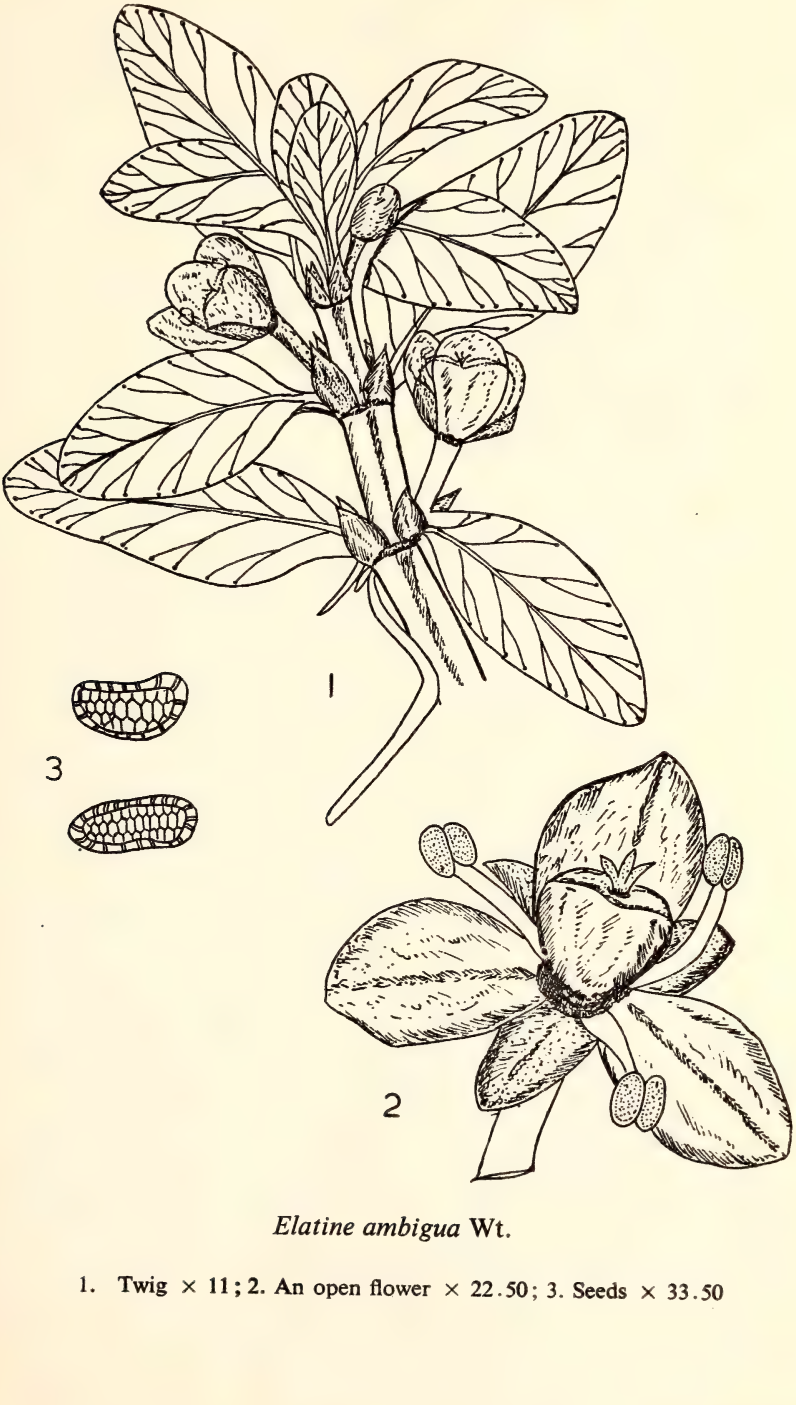
ENUMERATION OF PLANTS

ORCHIDACEAE

1. **Aerides maculosum** Lindl.
   Ahwa, *BS* 1115; Malegam, *BS* 1325.

2. **Habenaria digitata** Lindl. var. **digitata.**
   Malegam, *BS* 1332.

Shah : *Elatine ambigua* Wt.



Elatine ambigua Wt.

1. Twig × 11; 2. An open flower × 22.50; 3. Seeds × 33.50

3. **Habenaria grandiflora** Lindl.
Saputara, *BS* 1215; Malegam, *BS* 1333, 1355.

AMARYLLIDACEAE

4. **Crinum latifolium** Linn.
Ahwa-Borkhat Road, *BS* 1169; Saputara, noted on 20-7-1966.

5. **Pancratium triflorum** Roxb.
Ahwa, *BS* 1161, 1179.

HYPOXIDACEAE

6. **Hypoxis aurea** Lour
Saputara, *BS* 1216.

TACCACEAE

7. **Tacca leontopetaloides** (L.) O.K.
Malegam, *BS* 1194.

LILIACEAE

8. **Chlorophytum tuberosum** Baker
Ahwa, *BS* 1151, 1166, 1171.

9. **Iphigenia indica** (L.) Gray
Malegam, *BS* 1245, 1293, 1322.

10. **Scilla hyacinthina** (Roth) Macbr.
Ahwa, *BS* 1117, 1129, 1172.

COMMELINACEAE

*11. **Commelina paleata** Hassk.
Ahwa, *BS* 439.

12. **Commelina diffusa** Burm. f.
Bhavandaghad, *BS* 453; Ahwa, *BS* 567.

13. **Cyanotis fasciculata** Schult. f.
Ahwa, *BS* 70.

14. **Murdannia nudiflorum** (L.) Brenan
Ahwa *BS* 69

15. **Murdannia juncoides** (Wt.) Rolla & Kamathy
Ahwa, *BS* 67, 212.

ARACEAE

*16. **Arisaema neglectum** Schott
Malegam, *BS* 1198.

17. **Arisaema tortuosum** (Wall.) Schott
Malegam, *BS* 1362.

18. **Amorphophallus commutatus** (Schott) Engler
Ahwa, *BS* 1110; Malegam, *BS* 1212.

19. **Colocasia esculenta** (L.) Schott
Ahwa, *BS* 39.

APONOGETONACEAE

20. **Aponogeton natans** (L.) Krause & Engler
Ahwa, *BS* 561.

ACKNOWLEDGEMENTS

The authors are grateful to Rev. Fr. Santapau for critically going through the manuscript and for valuable suggestions; to Shri R. S. Rao, Regional Botanist, B.S.I., Poona for the identification of Commelinaceae and to Prof. P. V. Bole for facilities to work in the Blatter Herbarium. The authors are indebted to C.S.I.R. for financial aid to one of us (BS) to study the flora of Dangs forest.

DEPARTMENT OF BOTANY,
SARDAR PATEL UNIVERSITY,
VALLABH VIDYANAGAR,
GUJARAT STATE.

G. L. SHAH
B. SURYANARAYANA

November 9, 1966

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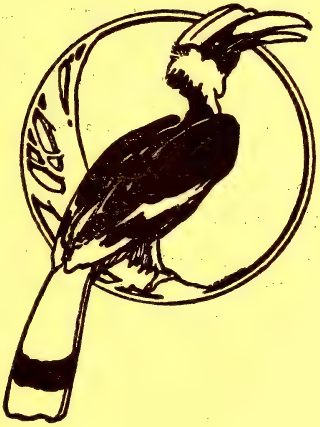

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The Birds of the Nicobar Islands, with Notes on some Andaman Birds

BY
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(*With a plate*)

INTRODUCTION

In 1964, I made a short visit to the Andaman Islands and the ornithological results (*J. Bombay nat. Hist. Soc.* **61** (3) : 483-571) indicated that the Nicobars, continuing 250 miles southwards towards Sumatra, would repay similar attention.

The 19 islands comprising the Nicobars are more scattered than the 204 in the Andamans, and it was evident that without a chartered vessel it would not be possible to visit many of them within the relatively short period of a few weeks. In 1965, illness in the family prevented me from taking advantage of an offer by the Ministry of Education (Science), Government of India, to finance such a project. By the next year, the several Surveys (Zoological, Botanical, Geological, Anthropological, and Meteorological) had decided on a joint trip and it was suggested that I join them. As it would obviously be impossible for a large party with such varying interests to function to everybody's satisfaction, I decided to work independently though with reduced financial assistance. The Ministry of Education (Science) first sponsored my trip and later agreed to pay half my costs.

With P. B. Shekar and Robert Grubh of the Bombay Natural History Society to assist with the collecting and skinning, I left Calcutta for Port Blair by *M. V. Andamans* on 19 February 1966, intending there to plan my further activities. The Survey parties, having finally decided to restrict their activities to Great Nicobar, sailed by the same vessel.

The morning of the 20th found us anchored in the mouth of the Hooghly. Pariah Kites (*Milvus migrans govinda*), Pond Herons (*Ardeola* *grayii*), Little Egrets (*Egretta garzetta*), Curlew (*Numenius arquata*), and Common Sandpipers (*Tringa hypoleucos*) were seen on the shore, while a flight of duck streamed across the horizon far away. A little after sunrise, several Blackheaded Gulls (*Larus ridibundus*) approached the ship, followed half-an-hour later by Brownheaded Gulls (*L. brunnicephalus*). A larger yellow-billed Herring Gull (*L. argentatus*?) flew about in the distance, while a pair of Brown-winged Terns (*Sterna anaethetus*) sat quietly on an adjacent buoy. Porpoises turned over not far from the ship.

By 4 p.m., land was almost out of sight, but some gulls including Brown-headeds and *argentatus* still flew around and with the boat. While they attended to the rubbish thrown overboard, it seemed at times that they were more interested in the wake of the ship, from which they picked up reddish morsels of shrimps or fish (?). Does the propeller kill and throw them into the wake? The Black- and Brown-headed Gulls often mobbed the larger gulls carrying food.

The next (21st) morning we were far out at sea, and long hours on deck (the cabins were not very comfortable!) twice revealed a Tropic-bird (*Phaethon* sp.) in the far distance. On the 22nd, when I was temporarily without my binoculars, a Tropic-bird flew low over the ship showing an all-white ribbon-like tail reminiscent of that of a Paradise Flycatcher, which I assume was the Longtailed Tropic-bird (*Phaethon l. lepturus*). Dragonflies were seen alongside the boat, no doubt 'carried down' from Calcutta. The sea was calm but showed occasional patches or broad ribbons of quite unruffled and paler-coloured water. Dr. A. A. Rama Sastry, the meteorologist of the larger party, informed us that these were 'slicks' and were produced by the oil exuded by large numbers of dead diatoms. I understand there are other explanations for this phenomenon.

On the 23rd we reached Port Blair and were soon among old friends, human and ornithological. The Jungle Crows (*Corvus macrorhynchos*) and House Sparrows (*Passer domesticus*), the racial identity of which had caused trouble (loc. cit.) again appeared different from those seen around Bombay. Though birds were numerous—I put up 30-40 snipe in a small bit of drying marsh—the variety was very limited. During the day I saw only 15 species, including four migrants and two introductions, the Myna and the House Sparrow.

There is no regular transport available southwards to the Nicobars. The Survey parties were transhipping to the *Yerewa* which was to take them to their first camp at Campbell Bay in Great Nicobar, and I went south with them intending to get off at Car Nicobar and spend a week there. We left on the 24th and touched at Little Andaman at about 4.30 p.m. the same afternoon. Some of us went ashore and met a party of 8/10 Onges,who like the Jerwas of the Andamans, are short in stature and of negroid origin. Most of them were dressed in a piece of string holding up a small rag ; the women were similarly clad, the rag being replaced by what appeared to be a tuft of grass and was later found to be the sliced-off top of a *Pandanus* fruit.

B. C. Roy of the Anthropological Survey, who was with us and who had spent some time in Little Andaman earlier, was very cordially received. After a preliminary hugging they squatted on the sand, sitting alternately in each other's laps. The Chief Commissioner of Scheduled Tribes, who was on an inspection tour on the same vessel, met and examined them very much in the manner in which most people would look at a strange and rare animal. I must confess that I am unable to understand some of these efforts. If what is left of these tribes is not absorbed into and developed into the normal Indian citizen, one would only appear to be treating them as a rare animal, outside a cage, with the certainty that the changes in the environment in which they have evolved, coupled with disease, will see them extinct within another generation.

Wild pigs are said to constitute the main food of the Onges who kill 3 or 4 every week. In the *Journal* (1962, **59** : 281), I have referred to the identity of these pigs ; I hope that some zoologist competent in this respect will study the series of skulls which is available at the Museum of the Anthropological Survey at Port Blair, and which it would no doubt be possible to borrow.

Morning saw us at Car Nicobar, a large flat island mostly under coconut, with occasional patches of *Pandanus* and cultivated *sopari* (betel-nut). Opinion was unanimous that I would be unable to move southwards in less than a fortnight, so I decided to continue. Major Sawhney, a very keen shikari to whom I was introduced on arrival there, took me round in a jeep. We shot a Swallow-Plover (*Glareola p. maldivarum*), the only one seen on the trip, at the aerodrome and listed a few birds. The Nicobar Green Pigeon (*Ducula aenea nicobarica*) with its long tail and often crow-like flight was frequently seen, as also the Emerald Dove (*Chalcophaps indica*). Twice we glimpsed the White-breasted Waterhen which I (1964) have separated as white-headed (*leucocephalus*) on the strength of a single specimen—one of them certainly had an all-white head.

The glare off the sand was intense and I had left my goggles on the boat. By lunch-time I had developed a violent headache and was feeling feverish. The doctor accompanying the party prescribed some pills which were inaccessible, being packed somewhere among the 1700 packages, but some were found with another member of the party.

I woke up much better next morning but did not dare land at Katchal, not far from Camorta, where I intended to have my first camp in the Central Nicobars. Grubh went ashore and brought in a few birds.

Being informed that another boat, following two days behind with luggage for the larger party, would be available to bring me back, I grasped the opportunity to see Great Nicobar, which I would otherwise have missed, and went on. Later in the day at Nancowry I attended a series of functions in honour of the Chief Commissioner of Scheduled Tribes, which included, in two hours, a formal reception including several speeches, a children's dance, a public meeting for complaints, followed by a children's song, a tea party, a boat race, and a tribal dance ! Several items were terminated halfway through, but the participants all seemed satisfied.

On 27 February we reached Campbell Bay on the east coast of Great Nicobar, where there was a small police wireless post established in a tiny clearing along the shore, surrounded on three sides by high trees. Two of the ' friendly ' Nicobarese who had danced at Nancowry were exhibited, presumably as members of the Shom-Pen tribe which lives in the interior and is still unfriendly. The Survey parties, 40 people supported by a labour force one and half times as many, now set about to establish territories and pitch their many tents. This required the felling of trees and the clearing of much undergrowth and there was considerable confusion for some time. I landed by the first boat and, leaving Grubh and Shekar to look after the luggage, went up one of the two paths that led away from camp. The Imperial Green Pigeon (*Ducula aenea*) was occasionally heard *ghooming* and I got glimpses of a parakeet. Several voices, including that of the Koel (*Eudynamys scolopacea*), were heard, but I saw only 13 species of birds during the whole day. In places the forest floor was pocked with crab-holes, occupied by a large red-clawed hermit crab (*Coenobita cavipes*) which lived in the hard shells of gastropod molluscs. Within a mile this path petered out and there was no means of proceeding further without the risk of going astray, nor was anybody in camp capable of acting as a guide—as I was to discover in due course. In the evening I walked inland along the shore of the bay. Here a stream said to be of fresh water entered the sea. It was closely lined with cane on both banks and a muddy bottom prevented one from proceeding very far inland. I had a much-needed bath but the water was salty to the point of bitterness.

Though several hundred yards of mud and coral foreshore were exposed at low tide, the high tide reached the *Barringtonia* along the beach, making it impossible to walk along the shore with dry feet. The *Barringtonia* and the forest beyond were impenetrable.

At night many noises were heard. A slow deep *truk truk truk* changing into a rapid *tuk tuk tuk*, with many variations, was traced to the large gecko (*Gecko smithii*), which I had met in Middle Andaman. At daylight (5 a.m.) they were calling again, together with others which it took some time to identify. The second path led to the beach on the other side, and with movements restricted in all directions it was soon evident that it would not be possible to do much collecting. Very few birds existed in that area and a whole day would pass with nothing new being seen. Also, I had not quite recovered from the ' stroke ' at Car Nicobar and was not perhaps as active as I might have been.

Working as hard as conditions permitted, we got some 60 birds of 20 species, including a pitta and the Olive Flycatcher which are peculiar to this area, and saw another 8 species including 4 migrant waders which we could not secure.

Several Tree Shrews (*Tupaia nicobarica*) were seen every morning, very squirrel (*Funambulus*)-like in their movements but not particularly active, all under 30 feet up in heavy forest. One of their calls was a very audible *trēē-oo*. They were seen to jump across a gap of 18 inches or so between the trees. Though they were not uncommon, we could not help wondering if the account in the relevant chapter in the report on the *Galathea Deepsea Expedition* 1950-1952 (1956) was quite correct. It says : ' . . . . on looking up saw between 20 and 30 small squirrel-like tree shrews'.

Dr. K. Thothathri of the Botanical Survey picked up half of a crocodile's lower jaw along the opposite shore, probably of *C. porosus* Schneider, which has been reported from the area.

We obtained a few bats. They were sent to Mr. J. E. Hill of the British Museum, whose report on the specimens is included in a comprehensive note on the bats of the Andaman and Nicobar Islands published in the last number of this *Journal* (pp. 1-12).

The Crab-eating Macaque (*Macaca irus umbrosa* Miller) has been recorded from the Great Nicobar, Little Nicobar, and Katchal Islands. Monkey footprints were seen on the shore on several occasions ; some members of the party, including Grubh, saw monkeys several times and they were probably this species.

In the forest I was twice shown ' beds' of drying vegetable litter (twigs and leaves) roughly 4 feet × 4 feet and 10 inches high, more or less reminiscent of material stacked in fields near Bombay for burning. They were said to be ' maternity beds ' used by wild pigs. One evening while out with Grubh, an all-black pig ran across our path. It appeared not as large as an Indian pig, and not as tiny as the one from the Andamans which is only 1/4 to 1/5 as large. It could not have been a domestic one run wild, for there is no human habitation near by. Grubh emptied a barrel of sixes in its direction and accelerated its movements.

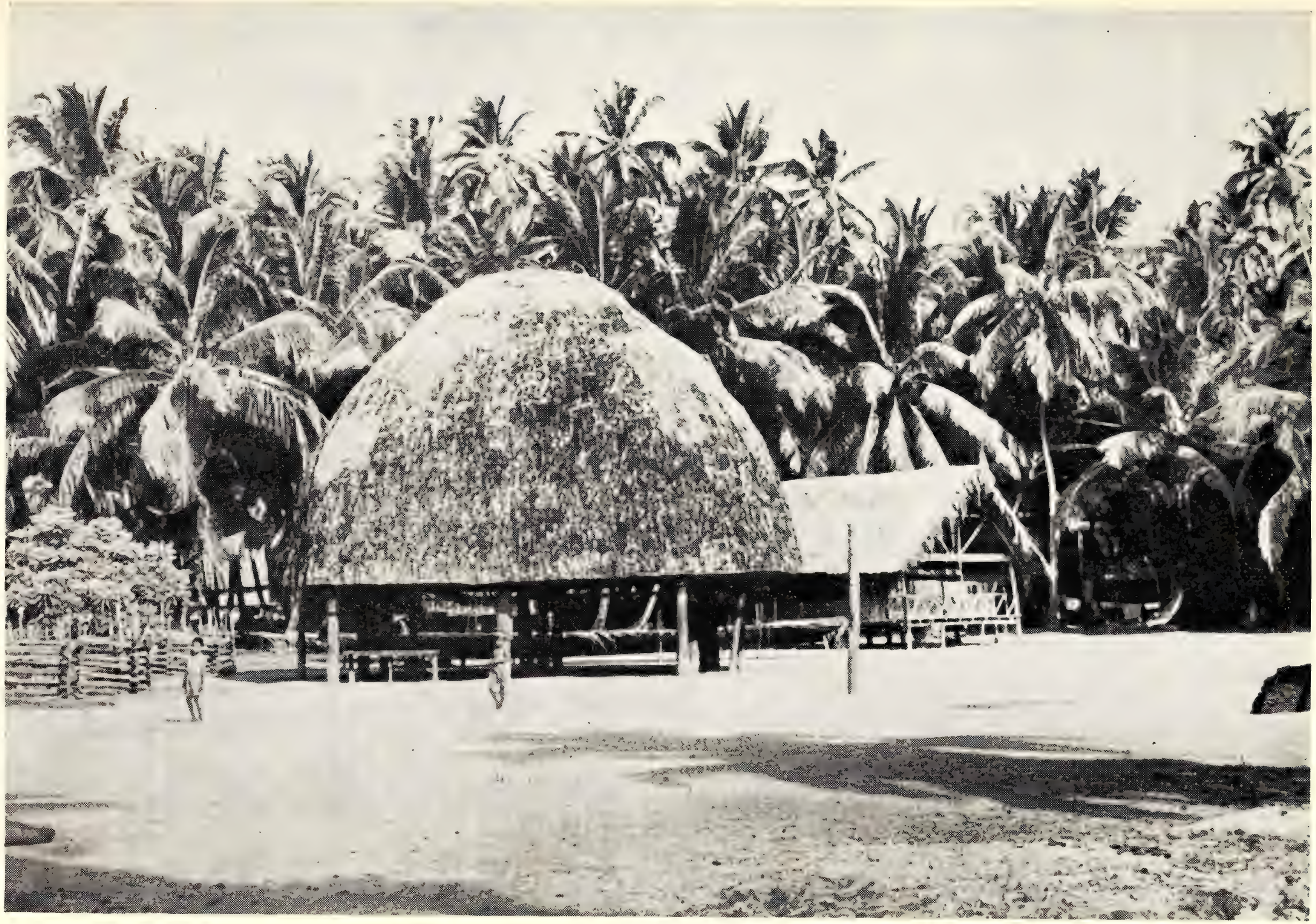
Megapodes were seen by several people but they were by no means common. A ' nest ' which I was taken to see on the opposite shore consisted of a mound about 3 feet high and 8-10 feet in diameter. It had largish excavations at the top, but the whole was crossed and re-crossed by roots upto ½ inch in diameter and was overgrown with small plants ! Another party claimed to have found a nest and produced the eggs which they had dug out from it. The chalky and rubbery nature of the shell and the small size and tubular shape left little doubt that they were lizard eggs, though they appeared small for a *Varanus salvator*.

At long last the boat came in and we left Campbell Bay on 8th March with few regrets. We sailed round the south end of Great Nicobar, past Galathea Bay which forms the mouth of the Galathea River, and then up the west coast on to Pulu Bhabi to drop the Anthropological party—they had not yet met the subject of their study !

Pulu Bhabi was a small village consisting of 5 or 6 round or rectangular huts raised on piles in a coconut grove and occupied by the Nicobarese. Pigs, dogs, chickens, and children wandered about, around, and under the houses. Upon our arrival, a young man ' walked ' up a coconut tree and threw down a number of coconuts. These were chopped off as expertly as one sees done on the Juhu shore near Bombay. After drinking the milk, the nut was handed back to the chopper who cleft it in two and then struck into the outside of one half, leaving a green sliver about an inch wide and two inches long, hanging on to the side. I first thought it was some form of fetish but discovered that this sliver when pulled off, served excellently as a spoon to work the kernel ! There was usually too much to eat and, as one threw it away, the pigs and dogs finished it off. The large Pied Imperial Pigeon which I had seen far out of gunshot at Campbell Bay was common, and perched on the coconut palms over our heads.

The following evening (9th) we got to Camorta in the Central Nicobars, where we had hoped to do the bulk of our collecting. The Dy. Commissioner, who was also on the boat, warned me about the large number of snakes on the island and said it was impossible to go out in the dark. I was looked at askance when I replied that it was perhaps a good opportunity to collect some. I had understood that some accommodation had been arranged for us at Camorta, and was surprised to learn that this had still to be done ! I was naturally anxious to make an immediate landing so as to start work the next day and the D.C. (who took off in the first canoe) promised to send up a boat to enable us to land. An hour passed and it got darker but there was no trace of the boat, and I went ashore in a canoe to find the D.C. comfortably lodged at home. On my pressing for my lodging I was told that the P.W.D. Bungalow on the shore was partly occupied by a military officer and the remaining room was too small to hold 3 beds, and the Forest Bungalow further up the hill was also partly occupied and it was not known what accommodation would be available.

After much argument I was put on my way to the latter, with a torch and a guide and yet another warning about snakes. Sure enough, just



Trinkut Island : A typical Nicobar Village

The domed building has no doors or windows. Entrance is by a ladder let down from a hole at the centre of the floor

(*Photo : Author*)

outside the D.C's garden the guide pointed to a largish green viper[1] in the middle of the path. I took the torch, put my foot on its neck, and attempted to seize it behind the head. There was some miscalculation somewhere and, before I realised what was happening, I had two long gashes along the middle of my right forefinger which bled profusely. Killing the snake with a stick, we took it to the D.C's house, to be told that its bite was fatal and I must rush to the hospital. A quarter of an hour had elapsed and, in the absence of any local swelling or irritation, I was confident that there was no poison to worry about. However, I was not averse to seeing the doctor who in due course lanced the bites and bandaged my finger. When we finally reached the Forest Bungalow, we found it quite empty! We then returned to the pier and, looking in at the P.W.D. Bungalow on the shore, found the vacant room quite sufficient to hold our party, with a verandah wide enough to permit skinning and other operations therein. Some of our luggage had already arrived at the pier and I occupied the P.W.D. Bungalow and slept ashore.

There were certainly more birds here than on Great Nicobar and we started off well. Fortunately we got in touch with Benjamin, who lives across the harbour on Nancowry, a keen shikari with a good knowledge of the local birds and a phenomenal capacity for finding birds dropped in grass and jungle. After I left he helped Grubh and Shekar with their collecting and secured many interesting specimens.

The two islands of Nancowry and Camorta lie only a mile apart, with their main villages of the same names on opposite shores. They were occupied by the Japanese during the last war. Heavy forest covers most of Camorta, but the undulating plateau about a mile from the pier is covered with grass and bracken with Japanese anti-aircraft guns still pointed skywards. Trenches and pits were dug all over the area and it was difficult to move freely, at least while looking at birds in the air. There were patches of evergreen forest with occasional tree-ferns and large mangrove forests along the shore.

One day we went across the few miles to Trinkut Island in a small canoe propelled by Benjamin and two small boys. Here were much larger areas of rolling hills covered with grass, which we beat up and down for the Blue-breasted Quail (*Coturnix chinensis trinkutensis*) described from one specimen obtained here by Abbott & Kloss (Richmond, 1903). Where the grass was more than knee-deep it was extremely difficult to walk through. Benjamin and another boy worked hard, but I was in poor condition and every half a mile or so had to sit down and rest. In short grass along a ridge we did put up a pair very blackish in colour, both of which flew in the same direction. I dropped one in higher grass but out of sight of Benjamin who was on the wrong side.

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[1] *Trimeresurus cantori.*

In spite of a long search, we failed to find it. Just as we were re-entering the forest, we flushed and collected a pair of Yellow-legged Button Quail (*Turnix tanki*) which were also on the wanted list. We moved on to a pond which was supposed to hold Whistling Teal (?) but the water was low and we got only a single Pintail Snipe. Other birds were flitting round the edges and I lay down to watch and rest while Benjamin went away to get some pigeons. When he returned after an hour or so, I sat up and was about to stand when a boy shouted ' Pytho pytho ' (Snake snake) and pointed to a small green viper between my legs. This was captured without difficulty and found to be *Trimeresurus cantori.* In a drying swamp lay a dead domestic pig, untouched by bird or animal, and drawing attention to the absence of crows, vultures, and other scavengers. A few yards away, in a mass of drying *Polygonum* sp., were a large number of small frogs (*Rana erythraea*) with discs on their toes and distinctive dorso-lateral lines of pale orange.

About this time the lower rib of the Society's 12-bore shotgun came loose, together with a portion of the lock. In the absence of any alternative, we stuck these parts together with Araldite (a product of CIBA's) and continued our work.

I had expected to be able to work around Camorta for at least a week, but now learnt that, if I did not leave by a naval boat on the morning of the 15th, I would not get another opportunity for a fortnight, with the additional risk of not being able to secure a reservation on the next weekly flight to Calcutta, for which I had a booking on the 21st. I was still feeling very shaky and, considering that a routine camp was now in operation, decided to leave.

My naval transport stopped a few hours at Car Nicobar, and I glassed many starlings (*Aplonis panayensis*) to find that they all had brown irises like those from the Andamans and not white as in Great and Central Nicobars. The latter have now been named *albiris.* I saw a raptor with almost white underparts which looked like a koel, flying slowly on quickly flapping and fluttering wings. Its call was softer and quite different from that of the Indian shikra, and it was presumably Horsfield's Goshawk (*Accipiter soloensis*) from Java which Abbott & Kloss found common on the southern Nicobars.

At the Guest House at Port Blair (16th), I returned to food and to comfort which I had not experienced for almost a month, and after a day's sleep I felt much better. Norman Young, with whom I left a jar in 1964, had pickled some geckos and other small fry. He also had a Whitebellied Sea-Eagle (*Haliaeetus leucogaster*) in immature plumage, which his son Maxie had skinned. Grubh had been tempted by a similar large target in easy range at Campbell Bay, and upon return to Bombay we discovered that the Society's collection held only one other skin of this species ! The space occupied by large birds makes them nondesiderata on collecting expeditions, and the same difficulty has applied to storage also. The Society has recently received a handsome grant from the Ministry of Education (Science) with which it is hoped that the storage problem will soon be overcome—the plumages of the larger birds have been poorly studied owing to lack of specimens, and I have no doubt that a closer examination will produce many interesting results.

At Port Blair I called on the Regional Naval Officer, Comdr, I. S. Bhati, to thank him for the lift, and discovered that he was a member of the Society and a keen bird shot. The few days' respite had almost put me on my feet, and we had a couple of pleasant snipe and pigeon shoots together.

Along the South Andaman Coast also, were remains of Japanese fortifications and gun-pits, one of the latter being used as a nesting colony by Whitebreasted Swiftlets (*Collocalia esculenta*)! On Saturday morning, 19 March, I left by air, reaching home the same night via Rangoon and Calcutta—a trip which had taken me six days on the way out !

Grubh and Shekar stayed on at Camorta till 30 March and then at Car Nicobar to 8 April. Here they took a boat to Calcutta, reaching Bombay by rail on the 19th. They obtained about a hundred additional specimens including several new to the collection.

The total collection, including a few I picked up at Port Blair, consists of 280 birds, 36 bats, 4 tree shrews, 29 snakes and lizards, 31 amphibians, as also a few odds and ends.

General remarks on the affinities and peculiarities of the avifauna of the Andamans and Nicobars cannot still be offered. I would however take this opportunity of drawing attention to the fact that there is evidence of the rapid diminution in numbers of several species over the last hundred years or less. The number of specimens of some species obtained by Davison and Hume are much more than the total number obtained by the Zoological Survey and my party in my two trips, though between us we must have put in almost the same time in the field. The first figures below indicate the number of specimens obtained by Hume and the second the total number obtained by the Zoological Survey and me.

Chaetura indica	.. 11	1
Psittacula caniceps	.. 25	1
Dryocopus javensis hodgei	.. 25	8
Chalcophaps indica	.. 35	6
Calaenas nicobarica	.. 54	3
Megapodius nicobarensis	.. 15	3

We did not visit Battye Malve which is the stronghold of the Nicobar Pigeon, but this bird was apparently common all over at that time. Davison (*Stray Feathers* **2** : 274) also refers to the tameness of this bird of which a dozen or more were seen feeding together on the ground 10 yards from where he sat.

It is true that we did not shoot everything in range, for there was some attempt at discrimination, but I cannot imagine that the number of specimens collected by Hume's party could even have been seen by us certainly not in all species. Conditions at that time appear to have been similar to those which Darwin found on the Galapagos about the same time and it would appear that the birds have paid for the trust which they showed in man. The Forest and other authorities in the Andamans approached me on several occasions for a list of Indian birds which could be introduced there—as indicated earlier, the commonest birds at Port Blair are perhaps the sparrow and the myna, both introduced, and among the larger mammals the chital, also introduced. We can only hope that the Administration, instead of making more introductions, will give the indigenous wild life the protection necessary to enable it to exist in the changing conditions.

After I had completed work on the basis of the material available in Bombay, I attended the XIV International Ornithological Congress held at Oxford in July 1966. This enabled me to have a quick look at parts of the gigantic collections at the British Museum (Natural History) in London, and permitted decisions where unanswered queries would have remained for an indefinite period. While in London, I received the happy news that the Zoological Survey of India were willing to place their collection of birds from Great Nicobar (72 of 29 species) and their post-war collections of non-Passerine birds from the Andamans and Nicobars (*c.* 120 of 34 species) at my disposal for study ; though this has delayed the completion of this paper, it has also helped in many ways. In the list which follows, I have detailed the number of specimens from the Zoological Survey's collections under each species from Great Nicobar only. If any of the Andaman notes are based on their specimens, specific reference is made to them.

While the paper was awaiting publication, I compiled a list of undecided items and sent them to the Smithsonian Institution. Dr. Ripley was away in Bhutan but as he was scheduled to return through Bombay I thought it would be a good opportunity to secure the specimens available in Washington and go over them with him in Bombay. Fifty-six specimens of 7 species collected by Dr. Abbott were sent by air but arrived here a fortnight too late ! They have however helped me clarify some points ; the necessary changes have been made in the text.

The limited bibliography for this area is repeated with a few additions. Four new races have already been described and the references are included.

ACKNOWLEDGEMENTS

I am grateful to the Sir Dorabji Tata Trust and the Ministry of Education (Science), Government of India, for financial assistance, to the latter again for sponsoring the trip, to Mr. Cassim Jadwet for the continuous collaboration and assistance received from members of his establishment at all ports in the Andamans and Nicobars. Lt. R. B. Vohra of the Indian Navy shared the P.W.D. Rest House with us at Camorta and was very helpful, and my assistants remember him with gratitude for the help he rendered after I left.

I am also grateful to Dr. B. Biswas of the Zoological Survey who, while at the British Museum in London, was good enough to look up several points which I had been unable to complete during my visit or which arose after my return ; to Dr. Dillon Ripley and his Research Assistant in Ornithology Mr. Gorman M. Bond at the Smithsonian Institution, who have continually looked up references and specimens available to them and helped me with specific difficulties ; to Mr. D. E. Reuben for continuously editing my manuscript and helping to reduce the number of mistakes and slips; and last but not least I must record my appreciation of the assistance and co-operation received from P. B. Shekar and B. R. Grubh of the Bombay Natural History Society, who worked cheerfully under difficult conditions and continued to work on their own after I left.

SYSTEMATIC LIST

Although this involves some duplication all the birds recorded from the Nicobars are mentioned, and, from the Andamans, only those regarding which some supplementary information is available or some correction is necessary. Square brackets are used for birds the records of which appear unsatisfactory and which are to be removed from one or both of the Andaman and Nicobar lists.

Notes on birds from the Andamans only are marked with an asterisk.

Round brackets without a number enclosed indicate that it has not been possible to determine the subspecies or that the species is not listed in the SYNOPSIS.

The scientific names, except where otherwise stated, are as in Ripley's SYNOPSIS and the serial number against each species is from the same source. Where a new scientific name or one not accepted by him is used the letter ' a ' is placed as an adjunct after the number of the last subspecies in his list.

[1][17. **Phaethon aethereus indicus** Hume (Mekran Coast) Short-tailed Tropic-bird.

Hume (1874 : 323) thought that a *Phaethon* with a 'white tail over two feet long' seen by Davison at Treis (Nicobars) was of this species. The description is insufficient and misleading, and when describing *P. indicus* (1876a : 481) he specifically omitted this species from the Andamans and Nicobars. Ripley was therefore correct in ignoring in the SYNOPSIS the earlier record by Hume.]

18. **Phaethon rubricauda rubricauda** Boddaert (Mauritius) Redtailed Tropic-bird.

Hume (1874 : 322) stated that the tropic-bird recorded from the Nicobars as *aethereus* by Blyth (1846 b : 374) was of this species ; there is no other record. The species is noted for the Nicobars with a query, probably correctly, in the SYNOPSIS.

*19. **Phaethon lepturus lepturus** Daudin (Mauritius) Longtailed Tropic-bird.

On 22 February 1966, while on *M. V. Andamans* (the day before we reached Port Blair from Calcutta), a single all-white bird with a long ribbon-like tail reminiscent of a Paradise Flycatcher, flew over the ship. It was quite close and, as it is unlikely that I would have missed the red bill of *P. aethereus* or the red tail of *P. rubricauda*, I assume that it was of this species. Earlier in the day, a couple were seen in the distance but the tail and other details were not visible even through binoculars.

37. **Ardea purpurea manilensis** Meyen (Philippines) Purple Heron.

1 ♀ Trinkut, Central Nicobars. Wing 363 ; tarsus 126 ; bill 125.

The specimen is in immature plumage which cannot be quite matched among the others in the Bombay collection. It is our only record from the Nicobars, where it had been seen by Abbott and Kloss (in Richmond, 1903). On my return journey, several were seen in a snipe marsh near Bambooflats, South Andamans, on 18 March.

( ). **Ardea sumatrana sumatrana** Raffles (Sumatra) Dusky Grey Heron.

Except for the birds said to have been seen at Trinkut, Katchal, and Great Nicobar by Abbott and Kloss (who also saw *A. purpurea*), there are no records from the Andamans or the Nicobars.

39. **Butorides striatus spodiogaster** Sharpe (Andamans and Nicobars) Little Green Heron.

3 ♂♂, 3 ♀♀, 1 o? Camorta and Nancowry, Central Nicobars ; 2 ♀♀ Car Nicobar ; U. S. NAT. MUS.: 1 ♀ Little Nicobar.

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[1] In *Ibis* 1966 : 628 A. S. Cheke reports seeing one *Procellaria pacifica* Gmelin (SYNOPSIS No. 9) at 05° 59′ N., 93° 29′ E. in the Bay of Bengal on 8 August.

Butler (1900 : 153) said that in the Nicobars (Car Nicobar ?) they were so numerous that at low tide 20 or 30 could be counted at one time. I saw one at a freshwater pool at Trinkut and another on the shore at Nancowry. After I left, however, Shekar and Grubh found them common in patches of mangrove and obtained several more.

Including those at the British Museum (N.H.) the 7 males and 17 females available measured :

	Males			*Females*		
			Wings			
Andamans	3	161-168(2)	av. 165·6	8	161-171	av. 167·6
Car Nicobar	0	....		2	172-173	av. 172·5
Central Nicobars	3	(1 mltg)	av. 180	6	168-181	av. 173·8
Little Nicobar		....		1	184	184
Great Nicobar	1	188	188		....	
			Bills			
Andamans	3	56(2)-60	av. 56·6	8	51-60	av. 55·3
Car Nicobar	0	....		2	57(2)	av. 57
Central Nicobars	3	56-61	av. 57·6	6	57-63	av. 59·8
Little Nicobar		....		1	65	65
Great Nicobar	1	5	65	0	....	

An increase in size southwards is noticeable but this cannot, except in the last, be associated with any differences in colour. The specimen (B.M. No. 13.3.73), the only one from Great Nicobar, in addition to its larger size is a much paler green above. U.S. National Museum Sp. No. 178305 obtained by Dr. Abbott at Little Nicobar is in immature plumage but also larger than the others. More specimens would probably indicate a separation of the southernmost birds.

42. **Ardeola grayii grayii** (Sykes) (Dukhun) Pond Heron or Paddy-bird.

In my earlier paper (1965 : 501) I had questioned the published evidence for the occurrence of the Pond Heron from the Nicobars. The British Museum (N.H.) however holds a specimen marked Camorta, originally correctly identified but found boxed with *A. bacchus.* Though individuals are larger, most *grayii* have their wings under 200 mm. against over 220 in *bacchus.* The latter in non-breeding plumage can be separated from *grayii* by the broader and yellower streaks on a more rufous-brown head. It would however appear to be rare in the Nicobars.

43. **Ardeola bacchus** (Bonaparte) (Malay Peninsula) Chinese Pond Heron.

I had discredited the record of this species from the Andamans, as it appeared to be based on a single juvenile listed by Sharpe (1898 : 212), in which plumage this species was said to be inseparable from *grayii.* B.M. Sp. No. 92.2.4.253 (o ? wing 216), marked 'Andamans' and boxed with *grayii,* has rufous feathers scattered round head and neck and suggested *bacchus*. Dr. Biswas who examined the specimen at my request also thinks that it is this species.

44. **Bubulcus ibis coromandus** (Boddaert) (Coromandel) Cattle Egret.

Abbott and Kloss (loc. cit. : 313) obtained an adult at Tillangchong, but there appears to be no other record from the Nicobars. Hume (1874 : 76) refers to seeing one in Galatea Bay, Great Nicobar, but later (p. 309) specifically stated that it was not observed in the Nicobars.

As in my earlier paper I have referred to none being seen in breeding plumage, I must mention that on 18 March 1966 many in a flock of 25-30 birds seen near Port Blair were acquiring it.

*46. **Egretta alba modesta** (J. E. Gray) (India) Large Egret.

As already recorded by me (1966a : 554), a specimen obtained on North Button Island, Ritchie's Archipelago, Middle Andamans, and originally noted as *Egretta i. intermedia*, is of this species and establishes its occurrence in this area.

[47. **Egretta intermedia intermedia** (Wagler) (Java) Middle Egret.

My earlier record of this species was erroneous (see above). Butler (1900 : 151) said it was found in both the Andamans and the Nicobars but there appears to be no evidence in addition to Hume's (1874 : 303) statement that, though he ' thought he saw it in the Nicobars, it is impossible to be certain '. Until further evidence is available it may be best to remove this species from the avifauna of both the groups.]

( ). **Egretta garzetta** subsp. Little Egret.

In 1965 (p.503) I had referred to the possibility of the birds from the Andamans and Nicobars being of the black-footed form *nigripes* from the Sunda Islands. The Zoological Survey's collection includes a female from Mannarghat, South Andamans, in which the feet are now concolorous with the legs, but similar conditions obtain in specimens from Peninsular India. This character therefore does not appear to be of value unless noted in the field.

Sharpe (1898 : 122) refers to one collected at Trinkut, Nicobars. We did not meet this species.

51. **Egretta sacra** (Gmelin) (Tahiti) Reef Heron.

3 ♂♂ (including 2 white), 1 ♀ Car Nicobar; 1 ♀ Camorta. ZOOL. SURVEY : 1 ♂, 1 ♀ Car Nicobar; 2 ♂♂, 1 ♀ Great Nicobar.

This heron in its different plumages of white and grey of different shades and extent is common along the rocky shores of most islands.

The 10 specimens available (6 males, 4 females) include 2 white birds (both males) one of which has no plumes on the back and neck as are present in all the others ; the other is asymmetrically marked with grey. Another grey bird appears to be moulting to a darker grey.

The sexes show no apparent differences in measurement which are slightly smaller than those indicated in the FAUNA (**6** : 352) with, perhaps, a slight tendency to become smaller southwards :

Wing 247-278 [250-293, not 280-293 as printed in the earlier paper (1965 : 503)] ; tail 78-94 (93-98), tarsus 60-68 (72-77) ; culmen 70-85 (70-86).

52. **Nycticorax nycticorax nycticorax** (Linnaeus) (Southern Europe) Night Heron.

Davison (Hume 1874 : 315) saw several on the freshwater pools of Trinkut Island (Nicobars) but there are no subsequent records and we failed to find it.

54. **Gorsachius melanolophus minor** Hachisuka (Katchal Is., Nicobars) Malay or Tiger Bittern.

ZOOL. SURVEY : 1 ♂, Great Nicobar. Wing 236 ; bill 42 ; tail 87.

Hume obtained specimens at Tillangchong and Camorta, and Seymour Sewell saw a pair at Camorta, but we did not meet it.

Boden Kloss (*Ibis* 1927 : 526-527) had questioned the validity of this race, but the four specimens from Nicobars, Katchal, and Camorta (2) in the British Museum are noticeably smaller :

	Wings	*Bills*
Nicobars (4)	226-235	41-44
India, Burma, and Malaya (FAUNA)	255-281	43-49

Two of them are in chestnut plumage and have their black crests tipped with chestnut instead of being all-black as in those from all other places. The single specimen from Great Nicobar mentioned above is small (wing 236), but though in a chestnut stage has an all-black crest.

56. **Ixobrychus cinnamomeus** (Gmelin) (China) Chestnut Bittern.

1 o ? Trinkut, Central Nicobars. Wing 160 ; bill 53 ; tarsus 50.

The specimen, obtained at a swampy pool in forest, was the only one seen. Hume obtained it at Tillangchong and Preparis, and Kloss at Camorta.

The wings of 17 specimens in the Bombay collection measure 151-160 av. 155·6, indicating that the figures 138-149 (once 156) in the FAUNA are in error. Indian birds in immature plumage have a central streak down the neck with supplementary streaks at the sides. The single specimen from the Nicobars has only the central streak, a character shared with two more from the Andamans at the British Museum examined by Dr. Biswas. With more material, this matter may be worth further examination.

57. **Ixobrychus sinensis** (Gmelin) (China) Yellow Bittern.

1 ♀ Bambooflats, South Andamans ; 2 ♀♀ Trinkut, Central Nicobars. ZOOL. SURVEY : 1 ♂, 1 ♀ Great Nicobar.

One bird, obtained at Trinkut at midday, was in a hunting posture.

Though the usual measurements of the bird from the South Andamans are not appreciably smaller than in the others, the bird looked inordinately small when picked up.

Including 7 at the British Museum (re-examined by Dr. Biswas) eleven skins (1 ♂ and 10 ♀♀) from the Andamans and Central Nicobars are all in sub-adult (?) plumage, while the ♀ from Great Nicobar shows the adult plumage with unmarked olive green sheen above. Though the number of specimens is small, there does appear to be an indication of the absence of the adult plumage in the Andaman and Nicobar (excluding Great Nicobar) birds and also of a preponderance of females.

88. **Dendrocygna javanica** (Horsfield) (Java) Lesser Whistling Teal.

At Little Andaman (24 February) we were told of 'hundreds of duck' at a pool a mile away from the landing and Benjamin took me to a pond on Trinkut where he expected to find duck, but the water was low and no duck. Both were presumably references to Whistling Teal, for Butler said it was abundant on some of the Nicobars and Kloss saw a peregrine make a dash at a flock at Camorta (Richmond 1903 : 307).

[94. **Anas crecca crecca** Linnaeus (Sweden) Common Teal.

In my earlier report (1965 : 505) I have given reasons for omitting the references to this bird in the Andamans and Nicobars in Stuart Baker's INDIAN DUCKS AND THEIR ALLIES]

*96. **Anas gibberifrons albogularis** (Hume) (Andamans) Grey Teal.

Fleming, *Proc. Biol. Soc. Washington* (1911, **24** : 215) described a white-headed race *leucoparea* from North Reef Island, off North Andamans, but this has not been accepted by subsequent workers. I had overlooked 3 old skins from Port Blair, South Andamans, in the Bombay Collection, which have a varying amount of grey on the chin, separating them from the 5 from Middle Andamans, obtained on my earlier trip, all of which have pure white chins.

Dr. Biswas, to whom I referred this matter, said there were only 2 skins of *leucoparea* (including a paratype) in the British Museum, but they looked quite different from those from the South Andamans ; the white on the head however was variable and did not warrant any firm opinion, leaving the validity of a northern race still to be determined.

141. **Accipiter badius butleri** (Gurney) (Car Nicobar) Shikra.

We did not find this species on Car Nicobar. Butler said they kept almost exclusively to the tops of high trees and had a shrill little double cry exactly like that of the Indian Shikra.

? 142. **Accipiter badius obsoletus** (Richmond) (Katchal Is., Nicobars) Shikra.

1 ♂ Camorta, Central Nicobars.

In the absence of material for comparison both in Bombay and at the British Museum, it is not possible to be certain of the identity of the single specimen obtained. The type specimens obtained by Abbott had crimson irides, while they were noted as orange-yellow in the present specimen.

143. **Accipiter soloensis** (Horsfield) (Java) Horsfield's Goshawk.

I saw a single bird in a coconut grove at Car Nicobar on 15th March. Until it settled, it looked more like an albinoid Koel than a Shikra.

Though I did not see another, it is apparently a common migrant to the Nicobars, Abbott and Kloss having obtained 12 specimens on Katchal and Great and Little Nicobars.

152. **Accipiter virgatus gularis** (Temminck & Schlegel) (Japan) Eastern Sparrow-Hawk.

1 ♀ Camorta, Central Nicobars.

This bird was identified by Biswas at the British Museum. There does not appear to be any earlier record of this bird in the Nicobar Islands, though it is the form accepted as nesting in South Andamans.

173. **Haliaeetus leucogaster** (Gmelin) (Prince's Is., Indonesia) White-bellied Sea Eagle. Car Nicobarese : *Muttayeya*[1]

1 ♂ Campbell Bay, Great Nicobar ; 1 juv. o ? Port Blair (coll. Norman Young). ZOOL. SURVEY : 1 ♂ Mannarghat, South Andamans.

This large eagle was seen at all the camps throughout the Nicobars. As on the last trip to the Andamans, I did not hear the *kak-kak-kak* call so distinctive in India. Grubh describes a very different sound. He also found a nest with one young on a high tree at Car Nicobar in early April. Hume (1874 : 143) saw a nest 80′ up at Nancowry. The specimen shot at Campbell Bay had a squid in its stomach, while at Camorta it was said to attack poultry.

200. **Spilornis elgini** (Blyth) (South Andaman Island) Dark Andaman Serpent Eagle.

The only record from the Nicobars is a specimen in the British Museum referred to by Blanford (FAUNA **2** : 362). There appears to be no reference to it in the papers and/or lists of those who have visited the Nicobars, and it may well be an error in labelling. Biswas examined the material at the British Museum and confirms my earlier opinion that the dark *elgini* and pale *davisoni* are very different and adds that, in addition to coarser and larger legs and feet, *davisoni* has larger and stouter claws.

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[1] This and other local names are from Butler (1899).

The Zoological Survey obtained a ♂ and a ♀ of the dark form *elgini* at Wrafter Creek, South Andamans, on 19 March 1964. Both have their wings 380 mm., which measurement is identical with the wing of the female obtained by me at Mannarghat, S.A., a little earlier. Curiously, 2 females of *davisoni* from South and Middle Andamans obtained on my earlier trip had their wing, 393 mm. The tail shows some variation, *elgini* 221-230, *davisoni* 238-250.

201. **Spilornis cheela minimus** Hume (Camorta, Nicobar Islands) Serpent Eagle.

A small eagle circling high over grassland on Trinkut, with a lot of white on the underparts, was probably of this species.

202. **Spilornis cheela klossi** Richmond (Pulo Kunyi, Great Nicobar Is.) Serpent Eagle.

Zool. Survey : 1 ♂, 1 o? Great Nicobar. Wings 262, 255 ; tails 168(2) ; bills 31, 28.

Twice seen perched on high trees in heavy forest in Great Nicobar. It was an amusing miniature of the ordinary serpent eagle. Both sat quietly like an owl, ignoring the ·22 bullets which went past them. On both occasions, I dropped the bird but was unable to find it and it is possible that they were entangled among the climbers and never reached the ground. None were seen circling or heard, a difference in habit which may be another good reason for treating this as a separate species as has been done by Dean Amadon (1964, Taxonomic Notes on Birds of Prey, *Am. Mus. Novit.* No. 2166).

( ). **Pandion haliaetus** subsp. Osprey.

Further to my records from the Andamans I saw one at Campbell Bay, Great Nicobar. The former were noted as of the nominate race, but I have since noticed that the Australian race *P. h. cristatus* Vieillot has been recorded from Malaya and Java and, in the absence of a specimen, it may be more prudent to leave this racially unnamed.

211. **Falco peregrinus peregrinator** Sundevall (Indian Ocean, off Nicobar Islands) Shahin.

In addition to the type, one believed to be of this race was collected by Abbott at Camorta in February.

225. **Megapodius freycinet nicobariensis** Blyth (Nicobar Is.) Megapode.

2 ♂♂ Nancowry. Wings 220, 239 ; tarsus 60, 64.

Both birds are greyish below and olive brown above, appearing very different from two old skins marked ' Nicobars ' in the Bombay collection, which are a rich rufous brown both above and below. One was collected by S. S. Stevens in 1906, and the other bears no date. This difference in colour has been said to be normal variation within the race, but it appears exceptional and is possibly due to the excessive foxing to which this species is said to be subject (Van Bemmel, *Treubia* 1947 : 19). At the British Museum I could find only one skin of this species from the Nicobars, collected by W. Davison on 29-1-1873, almost black above, and (from memory) quite different from those referred to earlier. The label was further marked ' Died in captivity—originally brought from Nancowry '. It was very similar to those collected by A. R. Wallace and others further south, and one must assume that the locality of origin is in error.

This form is said to occur in all the Nicobar Islands except Car Nicobar and Chaura, and south of the Sombrero Channel the Little and Great Nicobars are occupied by the next race, *abbotti*.

226. **Megapodius freycinet abbotti** Oberholser (Little Nicobar Island) Megapode.

At Campbell Bay, Great Nicobar, we got glimpses of Megapodes but failed to secure any. The Zoological Survey obtained one, but this is not available for examination.

*246. **Francolinus pondicerianus pondicerianus** (Gmelin) (Pondicherry, India) Grey Partridge.

In 1965, I had referred to this introduced bird being heard in city limits at Haddo, Port Blair, in 1963 and 1964. When I passed through again in March 1966, some additional building had been carried out and more of the scrub removed. No partridge were seen or heard and nobody could say that he had seen or heard it within the year. I do not know how far it had spread and if it still exists.

The subspecific identity of the form introduced into the Andamans can be confirmed as *pondicerianus* by Zoological Survey specimen No. 29785, a female collected by R. V. Sherard at Port Blair on 21 March 1952, which has the centre of the throat ochraceous.

254. **Coturnix chinensis trinkutensis** (Richmond) (Trinkut Is., Nicobar Group) Bluebreasted Quail. Car Nicobarese : *Mul.*

I spent a whole day on Trinkut Island where large areas of open undulating country, over a mile wide, are covered with a thick coarse grass, in search of this bird. A pair of dark quail was put up and they both flew in the same direction. Shekar again visited the island but, though he saw a few, he was unable to secure any.

315a. **Turnix tanki albiventris** Hume (Andaman & Nicobar Is.) Button Quail.

2 ♂♂, 1 ♀ Trinkut & Camorta. Wings ♂♂ 83, 85 ; ♀ 90.

The pair from Trinkut was put up out of short grass at the end of a long beat for the Bluebreasted Quail, on the border of tall grass and forest. The male had slightly enlarged testes. On Camorta, it was obtained in similar grassland on the hill near the Forest Rest House.

A bird from the Andamans was named *albiventris* by Hume (*Stray Feathers* **1** : 310) who later (op. cit. **2** : 281) thought it was not worth separating. Blanford however accepted it both from the Andamans and Nicobars, but subsequent authors have synonymised it with the nominate form (Type locality, Bengal).

The measurements of the three specimens agree with those of Indian birds, but all three are much darker above with little or no rufous. The rufous collar of the female is also much darker than in any from India.

While there can be little doubt that these are different from those from India and Burma, the name *albiventris* was given to one from the Andamans and I cannot say if they are identical.

330a. **Rallus striatus nicobarensis** Abdulali (Nancowry, Central Nicobars) Bluebreasted Banded Rail.

1 ♂ Nancowry, Central Nicobars.

This was the only specimen met with. It has been separated from the Andaman birds (Abdulali 1967b:420) but the form occurring in Car Nicobar is yet undetermined.

345a. **Amaurornis phoenicurus leucocephalus** Abdulali (Car Nicobar).

4 ♂♂, 1 ♀ Car Nicobar. ZOOL. SURVEY: 1 ♀? Car Nicobar.

This is very common on Car Nicobar. In my Andaman report (1965 : 514), I had referred to doubt being cast upon the validity of this race. An examination of the material at the British Museum (N.H.) revealed that they had no specimen from Car Nicobar. The five birds obtained on this trip have their heads entirely white (more than in the type specimen, extending down to the nape in a male and a female). The Zoological Survey's specimen No. 29865 from Car Nicobar has less white on the forehead (15 mm.) and is also more olive-green above and it would appear that the all-white head (and also the white forehead of Indian birds) is the adult plumage acquired in the second year or later, and in *leucocephalus* (which is restricted to Car Nicobar) is linked with a change from an olive-green to a grey back. In my description of *leucocephalus* I had referred to the difference in the amount of white in the lower plumage. On an average, the Car Nicobar birds do show more white, and it is in some *insularis* restricted to a narrow stripe down the centre. There is much variation in the specimens from widely separated parts of India and Burma, and in the absence of series from any restricted area, it is not possible to compare them in this respect with the birds from the Andamans and Nicobars, or to confirm that they are all *chinensis* as now accepted.

( ). **Amaurornis phoenicurus** subsp. Whitebreasted Waterhen.

2 ♂♂, 2 ♀♀ Camorta and Nancowry, Central Nicobars. Zool. Survey : 1 ♂ Great Nicobar. U.S. Nat. Mus.: 3 ♂♂, 1 ♀, 1 o ? Trinkut, Katchal and Tillangchong Central Nicobars ; 1 ♀ Great Nicobar.

The birds from the Central Nicobars appeared to differ from *leucocephalus* and this is confirmed by the additional material from the U.S. National Museum.

The white on the head extends only half-way across the top while the upper parts are olive-grey as in *insularis* and not greyish. The specimens available measure :

		Andamans *insularis*	Car Nicobar *leucocephalus*	Central Nicobars *subsp.*
Wings	♂	170-176 av. 172·5	165-176 av. 168·7	162-180 av. 171·5
	♀	154-161 av. 158·3	160-162 av. 161	159-164 av. 161·2
Bills	♂	40-42 av. 41·3	40-43 av. 41	41-45 av. 42·8
	♀	34-39 av. 37	36-37 av. 36·5	37-45 av. 40
White on	♂	9-12	Head all white	18-28
forehead	♀	9-13	in adult plumage	6-18

In the Central Nicobar birds the bills (and also the body) appear much heavier than is suggested by the measurements.

The ♂ and ♀ from Great Nicobar measure :
wings 158, 158 ; tail 61, 64 ; bill 34, 36 ; white on forehead 8, 8.

The olive-green upperparts indicate a similarity to *insularis* but they may both be juveniles of the race occurring in the Central Nicobars.

The single bird from Barren Island is included with those from the Andamans.

In the absence of any material or literature for comparison with the races described from Java and Timor, I can for the moment only draw attention to these differences.

Incidentally at the British Museum, I saw some specimens marked *A. p. maldivus* from the Maldives separated by Phillips and Sims (1958 *Bull. B.O.C.* **78** : 53) for more white on the forehead. These birds are quite different from *leucocephalus*, and I got the impression that a large part of the additional white on the wings was asymmetrical, indicating albinism.

Grubh's note, that several were heard calling together in chorus reminds me of Stockley's statement (*J. Bombay nat. Hist. Soc.* **29** : 719) that, in Siam in March, ' The report of a gun would set all the whitebreasted waterhens braying for miles along the river '.

346. **Gallicrex cinerea cinerea** (Gmelin) (China) Water Cock or Kora.

1 ♀ Bambooflats, South Andamans.

A single bird was put up in a small valley of drying grass on Trinkut.

A ♀ collected at Bambooflats, South Andamans, on 18th March has a 180 mm. wing. A larger and darker bird was seen in the same area.

371. **Pluvialis squatarola** (Linnaeus) (Sweden) Grey Plover.

A largish plover with black legs and bill seen with a number of sand plovers on a mud bank at Trinkut, Central Nicobars, was certainly this species. It has been recorded from the Andamans, but not from the Nicobars.

373. **Pluvialis dominica fulva** (Gmelin) (Tahiti) Golden Plover.

1 ♂, 1 ♀ Car Nicobar; 1 ♂ Camorta, Central Nicobars. ZOOL. SURVEY: 1 ♂ Great Nicobar.

Small parties were seen on Great Nicobar, Camorta, and Car Nicobar. Ferrar (*J. Bombay nat. Hist. Soc.* **35** : 449) said that some summered in the Andamans every year.

374. **Charadrius leschenaultii leschenaultii** Lesson (Pondicherry) Large Sand Plover.

2 ♂♂, 1 ♀ Camorta (2) and Trinkut, Central Nicobars.

The 3 specimens are grey above, without the brownish tinge in the 15 others from various parts of India in the Society's collections. The Nicobar birds also have distinct collars across the breast, those in the males being more rufous than in the female.

In the FAUNA (**6** : 175), the wing is said to be 128-140, but there is nothing under 138 mm. in the specimens examined. Ticehurst (Birds of Sind, *Ibis* 1923 : 661) had referred to 139-150 mm. and this would appear to be more correct.

In the field, when seen together, this bird is distinctly larger than *Charadrius m. atrifrons* and shows paler legs, though those of the latter are not black.

384. **Charadrius mongolus atrifrons** Wagler (Bengal) Lesser Sand Plover.

2 ♀♀ Katchal Is., 11 March 1966. ZOOL. SURVEY: 3 ♂♂, 2 ♀♀ Great Nicobar.

This species was seen at all the camps. In the hand the smaller wing is sufficient to separate it from the previous species.

385. **Numenius phaeopus phaeopus** (Linnaeus) (Sweden) Whimbrel.

1 ♀ Campbell Bay, Great Nicobar; 1 ♂ Camorta, Central Nicobars; 1 ♀ Car Nicobar.

Whimbrel were common along the shore at all camps. The tides run up to the forests leaving no shore for the waders. At Campbell Bay, a number were seen perched high up in a bare tree on the seaside at full tide, and also heard calling from the forested side of the camp at night.

388. **Numenius arquata orientalis** C. L. Brehm (East Indies) Curlew.

I did not notice it but, in addition to the specimen from the Nicobars obtained by Von Pelzeln (Ball 1873 : 85), Seymour Sewell (1922 : 985) noted them at Trinkut.

394. **Tringa totanus eurhinus** (Oberholser) (Tso Moriri Lake, Ladakh) Redshank.

1 ♀ Car Nicobar.

Not numerous but occasionally seen at Campbell Bay and Pulu Bhabi, Great Nicobar, and at Camorta. The British Museum has specimens collected in the Andamans in May, June, July, and September.

396. **Tringa nebularia** (Gunnerus) (Norway) Greenshank.

Hume (1874 : 299) did not obtain it but referred to a doubtful record by Von Pelzeln in the Nicobars. I saw it in the Andamans in November and February.

? 398. **Tringa glareola** Linnaeus (Sweden) Wood Sandpiper.

This widespread wader occurs in the Andamans as far south as Little Andaman (Zool. Survey specimen No. 29876) and has been obtained at Acheen, North Sumatra. Though not yet noticed, it probably passes through the Nicobars.

400. **Tringa terek** (Latham) (Terek River on Caspian Sea) Terek Sandpiper.

I saw a single bird on the shore at Trinkut Island on 11 March and this appears to be the first record of this species from the Nicobars.

401. **Tringa hypoleucos hypoleucos** Linnaeus (Sweden) Common Sandpiper.

1 ♀ Katchal Is., Central Nicobars. Zool. Survey : 2 ♂♂ Great Nicobar.

Though nowhere numerous, the Common Sandpiper was seen at all the camps. Davison found them present in the Andamans on 12 May and again on 24 August.

402. **Arenaria interpres interpres** (Linnaeus) (Sweden) Turnstone.

Hume noted it on many islands in the Andamans and Nicobars, and Butler found them abundant at Port Blair in May and again in the Nicobars in September. I saw some on South Andamans on 17 March, but did not notice any on the Nicobars.

406. **Capella stenura** (Bonaparte) (Sunda Islands) Pintail Snipe.

Hume saw it in the Nicobars. I shot one at a freshwater pool at Trinkut on 11 March, and Seymour Sewell (1922 : 981) noted it at Camorta, *411. **Scolopax rusticola rusticola** Linnaeus (Sweden) Woodcock.

In my earlier paper I had overlooked and omitted a record of this species from Port Blair (*J. Bombay nat. Hist. Soc.* **21** : 1085).

415. **Calidris ruficollis** (Pallas) (Southern Transbaikalia) Eastern Little Stint.

In 1965, I referred to the conflicting reports regarding the occurrence of this stint in the Andamans and Nicobars. Zoological Survey specimen No. 20880 a female, wing 102, collected on Little Andaman on 15 February 1961 is marked as of this species. It is greyer above than most *minutus* available for examination, but can be matched with one obtained near Bombay, which has a shorter wing. Stanford and Ticehurst (*Ibis* 1935 : 276) when dealing with Burmese birds say that in long series :

			Wing	*Tarsus*
♂ ♀ *minutus*	measure	..	92-99	20-21·5 and
♂ ♀ *ruficallis*		..	98-106	18·5-19·5

Other *minutus* from India have wings 104 and 105 mm., and there appears to be no certain method of separating *minutus* from *ruficollis* in the plumage in which they are with us.

It is accepted for the Andamans and Nicobars in SYNOPSIS.

416. **Calidris minutus** (Leisler) (Germany) Little Stint.

Hume (1874 : 298) named 12 birds from the area from December to June as *minutus* and objected to Lord Walden's identification of a *ruficollis*. Later, Butler said both species were common along the Andaman and Nicobar coasts in winter and he saw them up to May.

We did not notice any stints in the Nicobars.

[418. **Calidris subminutus** (Middendorff) (Stanovoi Mountains and mouth of the Uda) Longtoed Stint.

Biswas when commenting on the SYNOPSIS (1964, *J. Bombay nat. Hist. Soc.* **60** : 685) refers to a doubtful record from the Nicobars which may best be omitted.]

422. **Calidris testaceus** (Pallas) (Holland) Curlew-Sandpiper.

Davison and Butler both record it from the Andamans and Nicobars.

( ). **Limicola falcinellus** subsp. Broadbilled Sandpiper.

As in the last, Davison and Butler both noted it in the Andamans and Nicobars.

434. **Dromas ardeola** Paykull (India) Crab Plover.

Butler reported a flock of 60 or 70 birds on Car Nicobar. Abbott saw them at Katchal and Great Nicobar. We failed to see any.

443. **Glareola pratincola maldivarum** J. R. Forster (Open sea in the latitude of Maldive Islands) Collared Pratincole.

1 ♀ Car Nicobar.

Hume (1874 : 286) said it was found occasionally as a migrant in the Andamans and Nicobars. Our single specimen was shot on the aerodrome.

Vaurie in THE BIRDS OF THE PALEARCTIC FAUNA (p. 454) has treated *maldivarum* as a separate species. In addition to the differences shown in the tail (Abdulali, *J. Bombay nat. Hist. Soc.* **53** : 701), I now find that the shaft of the first primary in this bird is always brownish or a sullied white against shining white in the typical *pratincola*.

468. **Sterna sumatrana sumatrana** Raffles (Sumatra) Blacknaped Tern.

Blyth (1846b) said it bred abundantly in the Nicobars, but I have been unable to trace any details.

At Pulu Bhabi, Great Nicobar, I saw in the distance an all-white tern that may have been of this species but, as in the next two species, the absence of specimens leaves an unfortunate uncertainty. In my earlier paper (1965) I overlooked Stuart Baker's statement in NIDIFICATION (**4** : 383) : 'In the Andamans, Osmaston, Wickham and Anderson, found them breeding on Snake Island and other islands in company with colonies of Rosy Terns. .... '

( ). **Sterna anaethetus** subsp. Brownwinged Tern.

At Nancowry, Central Nicobars, I think I saw on 28th February a Brownwinged Tern, which has occurred as a straggler on the Andamans.

479. **Sterna bengalensis bengalensis** Lesson (Coasts of India) Lesser Crested Tern.

This species, which I had obtained in the Andamans, has also been recorded in the Nicobars (Blyth 1846 and 1863 b).

At Pulu Bhabi on 8 March, I saw a large tern dark grey/brown above with an orange-red beak. In addition to the size, the fact that it did not double back and periodically plunge into the water like *bengalensis* suggests *bergii* which, though not yet recorded, may well occur in this area.

481. **Anous stolidus pileatus** (Scopoli) (Philippines) Noddy Tern.

This species has been obtained in the Andamans and Ripley (SYNOPSIS) states that it nests on small islets in the Nicobars.

500. **Treron pompadora chloroptera** Blyth (Nicobars) Pompadour or Greyfronted Green Pigeon.

1 ♂ 1 ♀ (wing only) Campbell Bay, Great Nicobars ; 2 ♀♀ Katchal (1 wing only) ; 3 ♂♂ Camorta ; 1 o ? Trinkut ; 1 ♂ Nancowry ; 2 ♂♂, 1 ♀ Car Nicobar. ZOOL. SURVEY : 1 ♀ Great Nicobar.

This bird was seen at all camps occasionally in pairs, but usually high and inaccessible. A female shot at Katchal on 26 February was breeding.

This series is separable from *andamanica* Richmond by the lesser amount of yellow in the wing forming one distinct bar rather than two across the wing. The outer edge of the outermost primary coverts is also whitish or white in contrast to yellow in the Andaman birds. A similar character is visible in the undertail coverts. The Nicobar birds are also slightly paler green below, a difference very evident in series.

Blyth (1846 : 370) said it had only been observed upon the Southern Islands.

508. **Ducula aenea nicobarica** (Pelzeln), (Nicobars hereby restricted to Car Nicobar.) Green Imperial Pigeon.

1 ♂, 2 ♀♀ Campbell Bay, Great Nicobar ; 3 ♂♂ Camorta ; 1 ♀ Nancowry. ZOOL. SURVEY : 2 ♂♂, 1 ♀ Great Nicobar.

The Green Imperial Pigeon was perhaps the commonest bird in all the forested areas and the chief objective of the local shikari. Its call, audible wherever one goes, permits its being traced and the nature of the forest allows only a sitting shot. 10-15 may be obtained in a morning if one's attention is entirely devoted to it. The flesh is insipid and no better than a Blue Rock's.

The fruit of *Ficus* sp. was commonly eaten and one stomach contained *Syzygium* sp.

A fledged young, being fed by its parent outside the nest, did not have the expansible bill so noticeable in the adult.

Zoological Survey No. 29838 obtained at Car Nicobar is a young bird with wing and tail both not fully grown. The undertail coverts are dark chestnut as in *andamanensis* and the upperparts greener than in adults. Many of those shot and examined had enlarged gonads. One was (2 March) attempting to break off a dry twig, and another was sitting on a typical pigeon/dove nest high up in a forest tree, quite out of reach.

Including material at the British Museum, I have the following table of measurement :

Car Nicobar

	Wings	*Tails*
*6 ♂♂	253-265 av. 257	157-169 av. 161·5
3 ♀♀	246-250 av. 248	152-158 av. 155

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* Both wing and tail were not measured in some instances,

	Central Nicobars	
18 ♂♂	251-266 av. 258	160-176 av. 167
12 ♀♀	250-270 av. 258·4	152-167 av. 160·4
	Great Nicobar	
5 ♂♂	255-270 av. 265·2	159-180 av. 173·6
5 ♀♀	266-274 av. 269·8	164-183 av. 173·6

The species increases in size southwards from the Andamans but there appear to be no constant differences in the colour in the three groups in the Nicobars. In size however it is curious that the material indicates that, while the female is smaller than the male in Car Nicobar, she is as large if not larger in Great Nicobar. While the evidence appears to be insufficient to justify a new race, I have restricted the type locality of Pelzeln's *nicobarica* to Car Nicobar.

509. **Ducula bicolor** (Scopoli) (New Guinea) Pied Imperial Pigeon
Car Nicobarese : *Kaluia.*

2 ♂♂, 1 ♀ Pulu Bhabi, Great Nicobar ; 1 ♂ Camorta, Central Nicobars. ZOOL. SURVEY : 1 ♂ Great Nicobar (wing 245)

The males have their wings 237-245 (Camorta) against ' about 218-231 ' in FAUNA. At the British Museum I measured 6 males from Straits of Malacca, North Borneo, and other places south of the Nicobars as 222-236 av. 228 while Biswas measured 14 males from the Nicobars as 228-248 av. 235. There appears to be no doubt that Nicobar birds in series have larger wings than those from Malaya and southwards. All four show varying degrees of ' creaminess ' on the head and also on other parts of the body. It had been suggested that this is due to stains from nutmeg (*Myristica* sp.) and other fruits but, in the specimens available, several feathers on the rump show yellow at the base, darkest when in sheath. The colour has disappeared at the tips and it is most pronounced where covered by other feathers. In a separate note (1966b) I have suggested that the creaminess on the head and other parts is acquired on the bill and forehead from the yellow feathers on the rump and then transferred to other places in the course of preening.

I saw a few flighting northwards on several evenings at Campbell Bay, but far out of range. At Pulu Bhabi, on the west coast, they were tame and plentiful in twos and threes on the coconuts in the village of stilted huts. The two males collected had enlarged testes *c.* 25 × 10 mm., while the female contained a shelled egg which has been preserved. At Camorta and Trinkut they were quite common in some places and the few examined all had enlarged gonads (mid-March). They have the flapping flight of the Green Imperial, perhaps slightly faster.

In the Andaman paper (loc. cit. : 526), I referred to Osmaston having found it common and breeding on *North* Sentinel Island, 17 miles off

South Andamans. This is in error for *South* Sentinel. I also notice that I omitted to draw attention to Ferrar's (1934 : 214) interesting observation that on the same island, the pigeons used the roost of the flying foxes, flying away to South Andamans at daybreak when the bats came in. It has been referred to as a seasonal migrant also, but there appears to be little evidence to indicate the nature of its movements.

Butler's record of a chuckling *hu, hu, hu* was wrongly reproduced as *ku, ku, ku* in my paper (loc. cit : 526).

( ). **Columba livia** subsp. Blue Rock Pigeon.

Quite a few pigeons, including white and parti-coloured birds, lived in and around the Nankauri Trading Company's establishment at Nancowry. I also saw a flock circling the masjid at Port Blair. Boden Kloss (1903) referred to their being introduced into Car Nicobar in 1898 and seeing numbers ' in the vicinity of the bungalow in 1900 '. I do not know if they are still there.

525a. **Columba palumboides nicobarica** (Walden) (Nicobars) Wood Pigeon.

3♂♂ Campbell Bay, Great Nicobar ; Camorta and Nancowry, Central Nicobars.

As in the Andamans, this species was found in forest along with *Ducula aenea*, though much rarer. The call is a deep *whu* similar to that of *D. a. nicobarica*, but Benjamin could distinguish it as deeper and a syllable shorter. In appearance and habits it is very similar to the Imperial Green Pigeon, except that I got the impression that it was faster on the wing.

A male shot at Campbell Bay had the basal halves of the upper and lower mandible, a fleshy flap which covered the nostrils and the bare patch round the eye, bright red. Iris orange-yellow. Tip of bill ivory-white. Legs and feet magenta. Claws white.

The earlier notes on the races of this species were confusing. Stuart Baker and Ripley have both dropped Walden's *nicobarica* (1874) from Trinkut and Nancowry, separated on the basis of ' the entire head, nape, cheek and neck dark grey, and wanting the pearly-white or greyish-white head, throat and nape '. Hume denied the validity of this difference, an opinion which is confirmed by Salvadori (1893 : 308), where he lists the types of *nicobarica* with those from the Andamans.

A colour plate accompanying Walden's note on Andaman birds (1873) shows a bird with a dark head, while that in Stuart Baker's INDIAN PIGEONS AND DOVES (p. 180) is whitish and very like what I obtained in the Nicobars, but there is nothing to indicate the origin of the specimen treated as a model.

Though the material at the British Museum (7 Andamans, 5 Nicobars) did not definitely indicate that Nicobar birds had whiter heads than those from the Andamans, the eight birds (four from each group) available here clearly confirm this, in addition to which the southern birds have longer wings and tails :

		Wings	Tails
Andamans	♂♂(4)	242·5-257 av. 249·3	138-145 av. 141·5
Nicobars	♂♂(7)	254-260 av. 256·7	145-165 av. 155·8
Andamans	♀♀(6)	240-254 av. 246·7	122-156 av. 139·8
Nicobars	♀(1)	255	162

They also have the middle toe (with claw) 47-48 (5 ♂♂ 47-49) against 43-43·5 (3 ♂♂ 4 ♀♀ 43-46 av. 43·7). The measurements in parenthesis relate to the specimens at the British Museum (N.H.) which were very kindly obtained by Mr. Derek Goodwin of that institution.

Though the original description is confused, it would appear that the populations of the two groups of islands are distinct and it would be correct to resuscitate Walden's *nicobarica.*

527. **Macropygia rufipennis rufipennis** Blyth (Southern Nicobars) Nicobar Cuckoo-Dove.

2 ♂♂, 1 ♀ Camorta and Nancowry, Central Nicobars. ZOOL. SURVEY : 1 ♂, 1 ♀ Great Nicobar.

When I separated (1967 : 421) the Andaman birds as *andamanica* I assumed that the nominate race (described from ' Southern Nicobars ') would be found throughout the Nicobars. The large series (32 Andamans, 10 Nicobars) at the British Museum did not include any from Car or Great Nicobar, but a male and a female collected on the latter by the Zoological Survey differ from those from Central Nicobars in the male appearing less rufous on the underparts and the female appreciably more dusky on the upperparts. Blyth's description also stresses the rufous on the primaries, a character indistinct not only in the two from Great Nicobar but also in a single specimen from Kondal (which is near Great Nicobar) and in one of the two from Treis examined at the British Museum.

Though Hume, Blanford, and others state generally that this bird is common in both the Andamans and the Nicobars, we did not see it on Car Nicobar ; nor have I been able to trace any specimen or record from this island.

In the absence of any subsequent notes on its call, I must draw attention to Blyth's statement (1846b : 372) that the ' call is hoarse, deep and subdued, a sort of croaking sound, only audible when very near, and resembling ' o - o - o - o - ah ' repeated several times successively '.

It is curious that the males of this species should be barred on the underparts while in *M. unchall tusalia* (Blyth) it is the female that is so distinguished.

[539. **Streptopelia chinensis tigrina** (Temminck) (Java) Spotted Dove.

The only record of this species is a specimen brought in by Capt. Lewis. As the origin of other specimens brought in by him has been doubted, this species may be dropped, until corroborative evidence is available.]

*544. **Chalcophaps indica maxima** Hartert (Golapabung, South Andamans) Emerald Dove.

Hartert separated the Andaman birds on their larger size indicating wing measurements of :

3 ♂♂ 157-164   1 ♀ 165

I have measured 12 ♂♂ and 6 ♀♀ from the Andamans (including material at the British Museum and from the Zoological Survey) and they are very slightly larger than Indian birds :

		♂♂			♀♀	
Andamans	12	146-155	av. 151	6	142-162	av. 149·3
India	14	142-157	av. 149·25	8	138-150	av. 143·25

The box containing the Andaman specimens at the British Museum held a note to the same effect by Derek Goodwin.

No other differences have been accepted, but I think that the Andaman birds show some inclination towards the sootiness and other colour characters which are more pronounced in those from the Nicobars. In the 3 males now available from the Andamans, the two grey bars across the lower back are less distinct, the lower parts are more uniform in colour (the upper breast not darker than the lower as in Indian birds) and the collar round the neck darker with less grey.

In the single female also, the lower belly shows less contrast with the upper breast, and the two pale bars across the lower back are absent. There is no grey on the head. The rufous on the upper tail coverts (a character only seen in females) is more prominent than in any others in the Bombay collection.

A male from Port Blair (B.M. 1889.2.2.88) has irregularly-placed iridescent spots on the under surface.

(   ). **Chalcophaps indica** subsp.

1 ♀ (breeding) Camorta, Central Nicobars. U. S. NAT. MUS. : 3 ♂♂ Trinkut, Tillangchong & Katchal, Central Nicobars ; 1 ♂ Great Nicobar.

The four males from the U.S. National Museum confirm Blyth's statement (1846b : 371) that the birds which abound in the Central Nicobars differ from the Indian race ' in the deeper ash-colour of the nape, the bluer vinaceous hue of the underparts, while the bands on the rump, so conspicuous in Indian birds and also in its Australian near ally *Ch. chrysochloros*, are very indistinct'.

In the single female a sooty wash replaces the rufous on the underparts, round the neck, and on the upper tail coverts and makes it appreciably different from Andaman and Indian birds.

The wings of the males measure 148 (Great Nicobar)—153 (Katchal) (146-155 av. 151, in Andamans). Their tails, 73 (Tillangchong)—80 (♂ Trinkut and ♀ Camorta) av. 79·7, are noticeably shorter than in Indian (♂ 82-98 av. 90·4 ; ♀ 78-95 av. 87·3) and Andaman ♂ 84-96 av. 91 ; ♀ 84-90 av. 87) birds and it is probable that this character, together with the sootiness and the absence of two bars on the rump, left the impression of darkness noted in the field.

In colour characters, the Andaman males form a part of a cline towards India, but the shorter tail, if supported by the colour differences in a few more females, would warrant the separation of Nicobar birds.

A male from the Rhio Archipelago (south of Sumatra) (U.S. Nat. Mus. No. 181197) is very similar to those from the Nicobars.

( ). **Calaenas nicobarica** (Linnaeus) (Nicobars) Nicobar Pigeon.

ZOOL. SURVEY : 1 ♂ Great Nicobar.

Except for one doubtful sight record at Camorta, I failed to see this bird.

I have (1965 : 529) referred to older records of thousands breeding on Battye Malve, halfway between Car Nicobar and Central Nicobars. This island is now used by the Indian Navy as a target for shelling and it is possible that this has resulted in the destruction of its main breeding grounds, and in a great reduction in its numbers. It has of course been found nesting in other places also, e.g. South Sentinel Island by Osmaston.

It may be worth recalling that Osmaston noted that the egg can be distinguished from that of *Myristicivora* (*Ducula*) *bicolor* by the colour of the membrane underlying the shell imparting a delicate purple tinge to the egg of the former, the other being pure white or faintly yellow.

553. **Psittacula caniceps** (Blyth) (Nicobars) Blyth's Nicobar Parakeet.

1 ♂ Campbell Bay, Great Nicobar. Wing 220 ; tail 347.

This species is restricted to the islands of Montschall, Kondal, and Great Nicobar. At Campbell Bay, it was not uncommon and its harsh raucous call—a loud *kraan kraan*, not unlike a crow's, was often heard and separated easily from the screeching of *Psittacula longicauda*.

It was however difficult to obtain specimens and I got the impression that this was due to its habit of perching in leafy trees rather than on bare branches as do other parakeets.

556. **Psittacula longicauda nicobarica** (Gould) (Nicobar Islands) Red-cheeked Parakeet.

1 ♂ Car Nicobar ; 4 ♂♂, 3 ♀♀ Nancowry, Trinkut, Camorta ; 3 ♂♂, 1 ♀ Campbell Bay, Great Nicobar. ZOOL. SURVEY : 4 ♂♂, 3 ♀♀, 1 o ? Great Nicobar.

This bird was frequently noted at all camps. The loud call is not unlike that of *krameri* in India, though it was uttered more often when seated than in flight.

Eleven males from Great (7) and Central (4) Nicobars have wings larger than indicated in the FAUNA, 192 (one 182)-202 (FAUNA 186-192).

The adult males have red bills, the green of the back broken by a largish pale patch on the nape and upper back, and larger wings and tails than the subadults with black bills.

		Wings	*Tails*
6 adult	♂♂	195-202 av. 199·5	240 (one 160)-290
5 subadult	♂♂	192 (one 182)-197	192-224

The 7 females are slightly smaller, wings 178-195 av. 189, and the longest tail is 227 mm. One marked female has a red bill and the pale nape patch as in the adult male, while another has only a partly red bill. The other females have black bills.

The single specimen from Car Nicobar, a female taken on the earlier trip, has one wing 198 mm. (other 191).

[566. **Loriculus vernalis vernalis** (Sparrman) (Cachar) Indian Lorikeet.

In my Andaman paper I have drawn attention to the absence of specific evidence for its occurrence in the Nicobars. Abbott & Kloss said that it was found ' everywhere in the Nicobars ', but their non-mention of its occurrence in the Andamans leaves little doubt that ' Nicobars ' is in error for ' Andamans '. Hume's (1874 : 81) statement that it was seen on Kondal (between Great and Little Nicobars) loses value when later on page 186 it transpires that the bird was seen by Wood-Mason and not by Hume himself.]

*576. **Cuculus micropterus micropterus** Gould (Himalayas ; restricted to Simla-Almora Districts, by Stuart Baker in FAUNA) Indian Cuckoo.

ZOOL. SURVEY : 2 ♀♀ South Andamans. Wings 193, 197 ; tails 140, 145.

The two specimens obtained in March agree with Indian birds in size and colour.

580. **Cuculus saturatus saturatus** Blyth (Nepal) Himalayan Cuckoo.

ZOOL. SURVEY : 1 ♂ Great Nicobar. Wing 195.

Hume (1874 : 83 and 190) saw and heard it in both the Andamans and the Nicobars and obtained 2 specimens on Kondal. Butler also noted it as not uncommon in both groups in the summer months. We did not meet it.

586. **Chalcites maculatus** (Gmelin) (Ceylon) Emerald Cuckoo.

1 ♀ Teressa, Central Nicobars.

The specimen, shot during a 40-minute landing by Grubh and Shekar, was the only one seen on the trip. The bird ' when obtained had a rufous head ; the upperparts were green as in an Emerald Dove, but turned coppery in 3 days'—a male obtained in the Palni Hills (B.N.H.S. Col. No. 21781) in 1960 is still emerald green above. The bill was yellow, with the anterior half black, and an orange gape.

587. **Chalcites xanthorhynchus xanthorhynchus** (Horsfield) (Java) Violet Cuckoo.

This is included for the Nicobars in the SYNOPSIS, but I have not noticed the original record.

[( ). **Surniculus lugubris** subsp. Drongo-Cuckoo.

Kloss (in Richmond 1903 : 302) refers to one shot and lost on Katchal Island. It is rightly omitted in subsequent literature but it is also true that no small drongo is known from the Nicobars.]

592. **Eudynamys scolopacea dolosa** Ripley (Barren Is., Andamans) Koel.

1 ♂ Campbell Bay, Great Nicobar ; 1 ♂ Nancowry, Central Nicobars. ZOOL. SURVEY : 4 ♀♀ South Andamans. U. S. NAT. MUS. : 2 ♂♂ Barren Island and Great Nicobar ; 2 ♀♀ Little Nicobar, 1 o? Car Nicobar.

Though the Koel was obtrusive to the ear at Campbell Bay, and also frequently heard at the other camps, it was seldom seen and remained a phantom sound for a long time. In the absence of any crows it is difficult to imagine their breeding here, though the Grackle and the Imperial Pigeon have been suggested as possible hosts. In flight it appeared appreciably larger than Indian birds as is supported by the measurements.

	Wing	*Tail*	*Bill*
1 ♂ Barren Island	210	200	29
1 ♂ Nancowry	215	207	31
1 ♂ Great Nicobar	230	218	34
5 ♀♀ South Andamans	196-212 av. 203·2	181-206 av. 196·6	28·33 av. 31·8
2 ♀♀ Little Nicobar	201-211	191-197 (Moulting)	27·31

As indicated in my earlier paper, the wing-tail index in Andaman/Nicobar birds is not very consistent, ranging between 91 and 99 as compared to 91 to 103 in about 40 specimens from other parts of the country. The Andaman and Nicobar females however are more consistently marked with rufous above. The prominent rufous patch on the forehead visible in *malayana* from Assam (1) and Burma (2) is conspicuous in some.

In addition to their wings and tails, the bills are also appreciably larger than in Indian birds.

*603. **Centropus (sinensis) andamanensis** Beavan (Andaman Islands) Crow-Pheasant.

Nine specimens, from South (5) and Little (1) Andamans from the Zoological Survey together with my earlier specimens (3) from South Andamans, include only three males.

	♂		♀	
Wing	182-184	av. 183	180-198	av. 188·2
Tail	239-244	av. 241·5	228-261	av. 248·8
Bill	30-32	av. 31	31-34	av. 32·5

In my earlier paper, I referred to apparent differences both in size and colour noticed in the field which were not substantiated by the specimens obtained. It is now noticeable that the two males now available, which are smaller than the females, represent the palest (4 March) and the darkest (28 March) of the whole series, from which they are outstandingly different. The females do not show an equivalent variation. All the specimens were collected between 12 February and 28 March.

( ). **Centropus** sp.

Hume's party saw a red and black *Centropus* which appeared larger than *andamanensis*, both on Kondal Island in the Southern Nicobars and on Southern Jolly Boy in MacPherson's Strait, South Andamans. Hume suggested that it may have been *Centropus eurycercus* Hay which was procured at Acheen, a little further south in Sumatra.

618a. **Otus scops nicobaricus** (Hume) (Camorta, Central Nicobars) Nicobar Scops Owl.

♂ Campbell Bay, Great Nicobar. Wing 164 mm.

The only one seen was this bird, which flew over a clearing while I was waiting for bats. I do not remember having seen such hugely developed testes (26×14 mm.) in any bird. The stomach contained bits of a spider and a beetle (*Apogonia ferruginea* F.)

The fifth quill is longest, the first shorter than the eighth, and the tarsus not fully feathered.

645. **Ninox scutulata obscura** Hume (Camorta, Nicobars). Brown Hawk-Owl.

This hawk-owl, named from a single specimen, has been obtained at Katchal and Car Nicobar (Richmond 1903 : 304) and extends into the Andamans, where it is common in suitable habitats and where I had obtained several. We did not see it in the Nicobars, nor hear anything which we could associate with this bird.

647. **Ninox affinis isolata** Baker (Car Nicobar) Nicobar Hawk-Owl.

Zool. Survey : ♀ Great Nicobar. Wing 195 ; tail 216.

Stuart Baker who described this race states that it is found in Car Nicobar, Trinkut, and Camorta Islands. Great Nicobar is omitted but, in the absence of specimens for comparison, the specimen obtained agrees with the description of the race—the wing and tail are longer than in *N. a. affinis*. Compared with a ♂ from Baratong, South Andamans (Zool. Survey Reg. No. 29781) the secondaries and tertiaries are more prominently barred with fulvous and the legs and feet much longer and coarser. The tail tips are paler, almost white.

( ). **Strix selaputo** Horsfield (=*S. orientalis* Shaw) Malayan Wood Owl.

Blyth (1846 : 369) referred to a specimen obtained by Capt. Lewis in the Nicobars but not preserved, which he (Capt. Lewis) later identified with a skin from Malaya. Hume (1876 : 283) said the owl which Tytler saw and Capt. Beavan thought might be *S. selaputo* was probably a Barn Owl (*Strix De Roepstorffi*).

Very few specimens of the different owls occurring in the Andamans and Nicobars appear to have been collected and additional material is necessary to clarify matters.

686. **Collocalia fuciphaga inexpectata** Hume (Andaman Islands) Grey-rumped Swiftlet.

In the SYNOPSIS this bird is mentioned for the Andamans and Nicobars. Hume (1874 : 162) specifically referred to its absence from the Nicobars (except for a yellow nest found on Katchal Island, Central Nicobars) and Butler, who did not see it himself, said ' It occurs more rarely in the Nicobars ' possibly referring to Jerdon's statement[1] that some form of *Collocalia linchi* or *fuciphaga* (presumably building an edible nest) was found in the Nicobars. Abbott said they were shot at Camorta and occasionally seen on the other islands. Though we did not see any on this trip, I noted them as frequent on Car Nicobar on my former visit.

687. **Collocalia esculenta affinis** Beavan (Port Blair, South Andamans) White-breasted Swiftlet. Car Nicobarese : *Tulikoop*

2 ♂♂, 2 nestlings (in formalin) Car Nicobar ; 1 ♂, 2 ♀♀, 1 o ? Camorta.

We found this swiftlet well distributed throughout the Andaman and Nicobar Islands seeing them on Car Nicobar and at Camorta. Abbott and Kloss obtained six females along the shore of Little Nicobar.

The 2 females from Car Nicobar appear to have greyer upper breasts than the others, but this may be due to differences in preparation.

At Chiria Tapoo, South Andamans, we saw some going in and out of an old Japanese concrete gunpit by the side of the road. Entering it by a side entrance, I found several (5 or 6) groups or bunches of nests. Each bunch consisted of 2 to 4 nests apparently haphazardly stuck together. Several nests held C/2 but they were at such angles that it did not appear possible that more than one nest in each group could hold eggs, and the cursory examination also left the impression that each egg-bearing nest was in a different group. I wrote to Lord Medway whose reply reads in part : ' The situation you describe is common in *Collocalia* colonies where conditions are such (perhaps dry atmosphere or lack of destructive organisms) that old nests do not fall regularly after use. Especially where the ceiling is more or less horizontal, pendant groups of clustered nests are often found—I have definitely observed more than one nest in a bunch being used simultaneously, and I do not think it is safe to infer that it is the successive nests of a single pair that form such bunches.'

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[1] Possibly based on Barbe (1846 : 356).

723. **Alcedo atthis bengalensis** Gmelin (Bengal) Common Kingfisher.

1 ♂ Campbell Bay, Great Nicobar; 2 ♀♀ Camorta; 1 ♂ Car Nicobar. ZOOL. SURVEY: 2 ♀♀ Great Nicobar.

All *Alcedo* kingfishers collected were of this species—contra 2 *meninting* in the Andamans.

*726a. **Alcedo meninting rufigastra** Walden (South Andamans) Andaman Blue-eared Kingfisher.

Earlier (1965 : 541) I said that *coltarti* Stuart Baker from Assam could be separated from *rufigastra* Walden from South Andamans, by the former having more purple on the nape and sides of the head. The large series at the British Museum showed great variations and no specific differences were visible. The box contained a note by Mrs. Hall that *coltarti* and *scintillans* (Stuart Baker, Bankaroon, Tenasserim) are doubtfully separable from *rufigastra.*

*727. **Ceyx erithacus erithacus** (Linnaeus) (Benghala)

Breeding visitor (?) to Andamans (see under next form)

728. **Ceyx erithacus macrocarus** Oberholser (Great Nicobar) Three-toed Kingfisher.

1 ♀ Campbell Bay. ZOOL. SURVEY : 2 ♀♀, 1 o ? Great Nicobar.

I saw this twice on Great Nicobar, the Zoological Survey obtained 3 specimens, and Abbott and Kloss 10 from Great and Little Nicobar. At the British Museum, I examined 2 from Kondal (between Great and Little Nicobar), and one from South Andamans. I have been unable to separate them from Indian birds but the records appear to indicate that (1) the species is a relatively rare breeding migrant to South Andamans, (2) it has not been recorded from Car or Central Nicobars, (3) it is common further south. Sims (1957) in a detailed study of this species (*Jour. Linnean Soc. of London* **44** : 212-221) identifies Andaman birds as of the nominate form (Type locality : Benghala) and the Nicobar ones *macrocarus.*

*731a. **Pelargopsis capensis osmastoni** (Stuart Baker) Storkbilled Kingfisher.

I had separated (1964 : 414) the Andaman birds as *shekarii* for, though it had been referred to as *Ramphalcyon capensis osmastoni*, no formal description had been seen, leaving the latter apparently a *nomen* *nudem.* Confirmation has since been found in a footnote on page 416 of Vol. 3 of Stuart Baker's NIDIFICATION OF THE BIRDS OF THE INDIAN EMPIRE (1934) and this invalidates my name.

732. **Pelargopsis capensis intermedia** Hume (Galatea Bay, Nicobar)

1 ♀ Campbell Bay, Great Nicobar. ZOOL. SURVEY : 1 ♀ Great Nicobar. Wings 152, 153 ; bill 80, damaged ; tail 97, 92.

This kingfisher, which is much brighter blue above than the Indian or Andaman races, was not uncommon at Campbell Bay, but very elusive. One seen in forest cackled like a woodpecker and appeared interested (?) in hollow trees. The Burmese race *burmanica* has been known to nest in river banks and in holes in trees. The specimen was obtained on the seashore. We did not see it in the Central Nicobars. Though Stuart Baker (FAUNA **4** : 204) refers to an egg taken by Davison on Car Nicobar, Hume (for whom Davison was collecting) quite clearly states that it was seen only in ' the southern division of the Nicobars ' i.e. excluding Car Nicobar, and this statement is confirmed by Butler. There does not appear to be sufficient evidence to accept its occurrence anywhere except on Great Nicobar.

739. **Halcyon pileata** (Boddaert) (China) Blackcapped Kingfisher.

1 ♀ Trinkut, Central Nicobars. Wing 129 ; bill 61.

I saw one at Campbell Bay, Great Nicobar, and the specimen was secured after I had left the Central Nicobars, being relatively rare in all places.

743. **Halcyon chloris occipitalis** (Blyth) (Nicobars) Whitecollared Kingfisher. Car Nicobarese : *Sukkar.*

2 ♂♂, 1 ♀ Car Nicobar ; 3 ♂♂, 5 ♀♀, 1 o ? Central Nicobars.

This is one of the commonest birds on Car and Central Nicobars and often found at inland pools and in forests. The call is a curious cackle hardly like a kingfisher's. Hume said it was found on all the Nicobar Islands, and refers in his general account (1874 : 75) to seeing it along with other birds at Galatea Bay, Great Nicobar. But we did not notice it on Great Nicobar and I cannot trace any specific record of its occurrence there nor is any specimen from Great or Little Nicobar listed in Sharpe's CATALOGUE (Sharpe **18** : 265). It is possible that Hume has erred as in the case of the Cattle Egret (q.v.).

In all races of this species both sexes are accepted as similar, but some individuals have the upper surface of their primaries and tails a noticeably brighter blue than others. Examination reveals that of the 22 sexed specimens of *davisoni* and *occipitalis* from the Andamans (3+ ZOOL. SURVEY 5), Car Nicobar (7), and Central Nicobars (7), 8 of the 9 males are so distinguished against only 2 of the 13 females. The pale buff or rufous on the lower surface is linked with the blueness. In one female the difference is not very pronounced, while the other was obtained on the same day and place as the differing male which suggests a possible mix-up in the labels. Blyth (1846a : 51) has referred to a similar difference in this race, and it is possible that a more detailed examination may establish a difference between the sexes.

I have (1965 : 544) referred to earlier records of nests in ants' nests and Grubh found 3 eggs in a live termitarium in a tree 15 feet above ground.

748. **Merops philippinus philippinus** Linnaeus (Philippine Islands) Blue-tailed Bee-Eater.

2 ♂♂ Camorta and Trinkut ; 1 ♀ Trinkut, Central Nicobars.

Single birds and small parties were seen among trees in forest as well as in open grass-covered plain.

870. **Pitta sordida abbotti** Richmond (Great Nicobar) Hooded, or Greenbreasted, Pitta.

2 ♂♂, 1 ♀ Campbell Bay, Great Nicobar.

All birds seen were flushed off the ground in heavy forest. They appeared to fly low and to settle again on the ground, rather than up in trees as does the Indian Pitta (*P. brachyura*). Grubh however did see it perch on a branch a couple of feet from the ground. In flight the bird appears dark though the white spots on the wing catch the eye.

917. **Hirundo rustica gutturalis** Scopoli (Philippines) Swallow.

1 o ? Port Blair, South Andamans. Wing 112.

Swallows were seen at Car Nicobar (on last trip) and at Trinkut, Central Nicobars, where a bird was shot (wing 112) but not preserved. They were common at Port Blair in mid-March, and a specimen was obtained there.

[920. **Hirundo tahitica javanica** Sparrman (Java) House Swallow.

Butler (1899 : 557) referred to this species as a common resident in the Andamans, and said it was not recorded from the Nicobars ' but I believe a swallow which I saw on Car Nicobar in August was this species '. He also referred (1898 : 736) to a ' prettily pied ' specimen which he shot at Port Blair, which note I had omitted in my earlier paper. There does not appear to be any definite record of this bird from the Nicobars.]

*926. **Hirundo daurica japonica** Temminck and Schlegel (Japan) Striated Swallow.

Vaurie (1959 : 13) refers to a specimen ' doubtfully of this race ' from Port Blair in the Andamans. He informs me (*in epist.*) that this bird was obtained by Butler in January 1898, though it is not included in his list (Butler 1899, 1900).

950. **Lanius cristatus lucionensis** Linnaeus (Luzon) Brown Shrike.

2 ♂♂, 1 ♀ Camorta, Central Nicobars; 1 o? (juvenile) Car Nicobar.

This bird does not appear to have been recorded south of Car Nicobar. In 1965 (pp. 547-8) I had referred to some confusion regarding the occurrence of the nominate form in the Andamans. At the British Museum (N.H.) a large series from this area, collected mostly by Davison and R. G. Wardlaw Ramsay, has been divided into two groups, one with a grey head *lucionensis* and the other brown *cristatus*. The bird with brown head and upperparts which Dr. Ripley (loc. cit.) had identified as an immature *lucionensis* could be matched with one marked *cristatus* (B.M. Reg. No. 86.11.1.1278). The other seven so marked (collected between 27 March and 26 August) are all strongly barred in front, but none of them has the distinct rufous cap which marks some of the *cristatus* from Burma and Malaya.

Stuart Baker (FAUNA **2** : 302) said that the young of *L. c. lucionensis*, could be separated from *L. c. cristatus* at all stages by the greyer head, while Chasen (1939, THE BIRDS OF THE MALAY PENINSULA **4** : 339) separates adult *lucionensis* by the 'pale grey and not reddish-brown' top of the head, and adds that in young birds 'the upperparts are dull brown and lack all reddish tinge'.

Though it has not been possible to examine this with sufficient care, I am inclined to suggest that only one race occurs in this area. Osmaston (1906a : 157) said it was a seasonal visitor to the Andamans arriving in September and leaving in April. Though there is no evidence of its breeding in this area it will be noticed that they have been collected in June, July, and August.[1]

957. **Oriolus chinensis macrourus** Blyth (Nicobar Islands, Central Group) Blacknaped Oriole. Car Nicobarese: *Macheon.*

Car Nicobar 3 ♂♂, 1 ♀, 2 oo?; Central Nicobars: 2 ♂♂ Nancowry, 2 ♂♂ 1 ♀ Camorta, 1 ♂, 1 ♀ Trinkut; Great Nicobar 1 ♂. ZOOL. SURVEY: Great Nicobar 4 ♂♂, 5 ♀♀.

Blyth described this bird from the Nicobars without specifying any island, but later (1846b : 370) said that it was observed only on the Central Island.

The birds from the 3 groups of islands show no differences in size, but Blyth in the original description refers to two small characters—a slight margin of whitish to the longest primaries, and a slight yellow border to the secondaries—which varies fairly consistently. In Car Nicobar, the white margin to the primaries is more pronounced while in Great Nicobar it is only visible in the juveniles and an immature female.

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[1] My specimens were re-examined by Dr. B. Biswas and Mr. P. K. Das at the Zoological Survey of India, Calcutta, together with the material available there, and they agree that there is no satisfactory evidence for the occurrence of the nominate form in the Andamans and Nicobars.—H. A.

Similarly, the Car Nicobar birds have more yellow on the edges of the secondaries, and this is absent in the southernmost birds which show a completely black closed wing. With a larger series it may be possible to name one or more subspecies.[1].

981. **Dicrurus paradiseus nicobariensis** (Stuart Baker) (Kondal, Nicobars). Racket-tailed Drongo.

2 ♂♂, 2 ♀♀ Campbell Bay, Great Nicobar. ZOOL. SURVEY : 2 ♂♂, 1 ♀ Great Nicobar.

This bird was quite frequently seen at Campbell Bay and again at Car Nicobar where unfortunately no specimens were obtained. We have no specific note of its being seen in the Central Nicobars. A male shot on 27 February had enlarged gonads. About the same time, attention was drawn to a bird calling from a nest in a bare tree some 80 feet up. After we had located the call, the bird left the nest which was almost immediately occupied by another.

Measurements of Andaman birds (*otiosus* Richmond) are compared with those from Great Nicobar :

Andamans		*Great Nicobar*
	Wings	
4 ♂♂ 153-164 av. 160·25		4 ♂♂ 150-156 av. 153·5
2 ♀♀ 155-156 av. 155·5		3 ♀♀ 147-155 av. 151·3
	Bills (from anterior edge of nostril)	
♂ 24·5-26		24-25
♀ 23·5-24		22 (one only, others damaged)
	Tails	
4 ♂♂ 342-431 av. 382·5		3 ♂♂ 294-357 av. 346
2 ♀♀ 344-351 av. 347·5		3 ♀♀ 308-322 av. 315

The projections of the bare shaft and racket of the outer feathers beyond the rest of the tail vary between 55 and 65% of the whole length and do not show any differences in the two races.

The Great Nicobar birds (including one from Kondal at the British Museum) are smaller in all respects, the most noticeable factor being the width of the web of the racket.

Andamans		*Great Nicobar*
	Largest web in racket of tail	
♂ 97 × 23		89 × 17
♀ 87 × 23		91 × 19

All Great Nicobar birds have a small but distinct crest, more evident than in Andaman birds (cf. FAUNA **2** : 376 and 380).

986. **Aplonis panayensis tytleri** (Hume) (Andamans) Glossy Tree Stare. Car Nicobarese : *Tukkuliv*

4 ♂♂, 1 ♀, 1 o ? Car Nicobar.

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[1] Oberholser's (1926) description of *eustictus* from Car Nicobar is not available.

986a. **Aplonis panayensis albiris** Abdulali (Campbell Bay, Great Nicobar).

6 ♂♂, 4 ♀♀ Central Nicobars ; 6 ♂♂, 3 ♀♀ Great Nicobar.

In most camps this was one of the commonest birds, being made more prominent by its habit of perching on bare trees along the sea-shore—Hume obtained 66 specimens.

In my earlier paper (1965 : 552), I drew attention to Hume's general statement that the irides in adults showed great variation ranging from white through opalescent white, fleshy white, and pale pink to brown, deep brown, deep red-brown, and deep orange. Later Abbott & Kloss (in Richmond, 1903) said that the birds from Car Nicobar had brown irides, while all from the central group and Great and Little Nicobars had them white.

Large numbers were seen and quite a few handled on Great Nicobar, Camorta, Trinkut, and Nancowry and, as they all, both adults and immature (spotted), had white irides while those from Car Nicobar and the Andamans had them brown, I have separated the southern white-eyed birds as *albiris* (Abdulali, 1967a).

At Campbell Bay, a ♂ in immature plumage had one testis 6 × 3 mm., and the other half this size. In all cases, the males have slightly larger wings than the females.

991. **Sturnus erythropygius erythropygius** (Blyth) (Car Nicobar) Whiteheaded Myna.

3 ♂♂, 2 ♀♀ Car Nicobar (including 3 on last trip).

This bird was quite common at Car Nicobar.

992. **Sturnus erythropygius katchalensis** (Richmond) (Katchal Is., Nicobars) Whiteheaded Myna.

Richmond in 1903 described *katchalensis* from Katchal in the Central Nicobars as similar in size and appearance to *andamanensis* and suggested that it was a hybrid population between *andamanensis* (which had been introduced at Camorta 4 miles east) and *erythropygius*, which has been accepted as probable in Ripley's SYNOPSIS.

We did not see this bird at Camorta, Nancowry, or Trinkut and there is no evidence that the population introduced at the first place survived for any time. Nor is there any evidence that *erythropygius* or any form of it occurred in Camorta, with which it could have hybridised.

The U.S. National Museum lent me a male and female collected at Katchal by Dr. Abbott, and a comparison with the fresh material from the Andamans and Nicobars calls for the following remarks :

The FAUNA (3 : 39/42) suggests that *erythropygius* is larger than *andamanensis*, but except for slightly heavier bills the following measurements do not confirm this :

	Wing	*Tail*	*Bill*		*Wing*	*Tail*	*Bill*
Andamans							
2 ♂♂	107 (worn) - 117	76-78	20·5-21	2 ♀♀	107-108	72-74	20-21
Car Nicobar							
3 ♂♂	110-112	76-78	23-24	2 ♀♀	106-108	65-71	22-23
Katchal							
1 ♂	107.	64,65*,71*	22*	1 ♀	106	64-65*	22

Mr. Bond, very kindly examined the type and two other specimens of *katchalensis* available to him ; his measurements are marked with an asterisk.

The birds from Katchal, in addition to their shorter tails differ from *andamanensis* (as do *erythropygius*) in having rufous in the tail and the undertail coverts, the latter being slightly paler than in *erythropygius*. In *andamanensis* the undertail coverts only show a slight tinge of rufous or none at all. Both the Katchal specimens showed dark-grey feathers on the forehead and chin, but Mr. Bond informs me that this is a characteristic of all of Abbott's specimens and may be due to some preservative that he used on the skins. From the evidence available, it would appear that *katchalensis* is a separate form restricted to Katchal which is only a few miles west of Camorta.

995. **Sturnus sturninus** (Pallas) (Dauria) Daurian Myna.

Hume (1874 : 251) refers to 2 shot out of a flock of 70-80 at Camorta, and a third which flew on to the boat between Little Andaman and the Nicobars. They were all in immature plumage. Hume did not appear quite sure about their identification, and I wonder if the statement in the SYNOPSIS that ' it is probably a regular winter visitor to the Nicobars ' is justified.

1006. **Acridotheres tristis tristis** (Linnaeus) (Pondicherry) Common Myna.

Abbott & Kloss (Richmond 1903) found them pretty numerous about the abandoned settlement at Nancowry Harbour, and said it had been introduced. We did not meet it and it has probably died out.

1018. **Gracula religiosa andamanensis** (Beavan) (Andamans) Hill Myna.

1 ♂, 2 ♀♀ Camorta and Nancowry, Central Nicobars.

We did not meet it at Car Nicobar. Blyth (1846b : 369) said that it was found in the southern Nicobars only.

1018a. **Gracula religiosa halibrecta** (Oberholser) (Little Nicobar).

2 ♂♂, 2 ♀♀ Campbell Bay, Great Nicobar. ZOOL. SURVEY : 3 ♀♀, 1 o ? Great Nicobar.

The birds from Great and Central Nicobars are in series more glossy above than those from the Andamans. They also increase in size southwards, as may be seen from the following measurements which include specimens measured at the British Museum :

Wings

Andamans	6 ♂♂ 165-175 av. 169·5	4 ♀♀ 160-166 av. 162·7
Central Nicobars	3 ♂♂ 172-179 av. 174·6	4 ♀♀ 167-170 av. 168·2
Great Nicobar	3 ♂♂ 180-182 av. 181	9 ♀♀ 172-181 av. 177

Tails

Andamans	6 ♂♂ 81-86 av. 82·5	4 ♀♀ 71-82 av. 77·75
Central Nicobars	1 ♂ 89 89	2 ♀♀ 83-84 av. 83.5
Great Nicobar	2 ♂♂ 87-89 av. 88	9 ♀♀ 83-95 av. 86·5

*Bills**

Andamans	3 ♂♂ 22·5-23	1 ♀ 23
Central Nicobars	1 ♂ 23	2 ♀♀ 20-23
Great Nicobar	2 ♂♂ 20-22	5 ♀♀ 19-22

* Measured from anterior nostril.

The birds from Great Nicobar can however be separated from all the others by having the two large naked lappets joined at the back of the neck at the top end, leaving no feathered portion in between. The gap varies with the method of preparation of the skin and, though the lappets are very close together in some from other places, none actually meet as in the Great Nicobar.

Oberholser's *halibrecta* was described from Little Nicobar as ' similar to *andamanensis* from Andaman but larger. Wing 184·5 ; tail 93 '.

Mr. Bond very kindly examined the type and tells me that although the lappets are distorted ' they do indeed appear to be joined ' and there can be little doubt that the birds from Great and Little Nicobars are of the same form.

The Oxford University Museum, which had some skins collected by Osmaston (presumably in the Andamans and/or Nicobars), included 3 with the lappets touching but the labels bore no locality.

At the British Museum I handled a few skins from Central Nicobars which were marked *andamanensis* and, though I noted them as ' similar to *intermedia* but larger ', I am leaving them under *andamanensis* until I have had the opportunity of examining a more representative series.

[1057a. **Corvus macrorhynchos andamanensis** Tytler (Port Blair, Andamans) Jungle Crow.

A few were taken from Port Blair and released on Camorta (Hume 1874 : 244) but there is no evidence of their survival. Later, Hume in ' A second list of the Birds of Tenasserim' (*Stray Feathers* **3**:325) compares Tenasserim birds with those from the Nicobars, but this is an apparent slip for the Andamans.]

[1076. **Coracina striata dobsoni** (Ball) (Andamans) Barred Cuckoo-Shrike.

In my earlier paper (1965 : 557), I have referred in error to Richmond's measurements of this species from the Nicobars. Richmond really referred to Andaman specimens and there is no record of this species from the Nicobars.]

( ). **Lalage nigra davisoni** Kloss (Nicobar Islands). Pied Cuckoo-Shrike.

3 ♂♂, 2 ♀♀, 1 o ? Trinkut & Camorta, Central Nicobars.

Stuart Baker (1924, FAUNA **2** : 341) restricted the type locality of *L. n. nigra* (Forster, 1781 'India') to Camorta, in the Central Nicobars. Boden Kloss (1926, *Jour. Malayan Branch, Royal Asiatic Society* **4** : 158) when naming the Nicobar race explained that Forster's 'India Orientale' was not the same as India proper, and agreed to Bangs' restriction of the type locality to Singapore (*Bull. Mus. Comp. Zool., Harvard,* LXV, 1922, p. 80).

I saw very few of these shrikes at Camorta and Trinkut, but Grubh and Shekar obtained several. This has not been recorded from Car Nicobar or Little and Great Nicobars, though Davison obtained it at Acheen in northernmost Sumatra.

The birds were seen in small parties and appeared very like minivets in their flight and general behaviour.

*1113. **Pycnonotus atriceps fuscoflavescens** (Hume) (Port Mouat and Mt. Harriet, South Andamans). Black-headed Bulbul.

In 1965 (p. 558) I omitted to draw attention to the fact that the males obtained differed from the two females in having a varying amount of grey on the head, which was olive-green and concolorous with the back in the females. A breeding male has the darkest, almost black, head, while its underparts are also a clearer yellow as against various shades of greenish-yellow in the others.

1122. **Pycnonotus jocosus whistleri** Deignan (Cinque Is., south of South Andamans) Redwhiskered Bulbul.

5 ♂♂, 1 ♀ Trinkut and Camorta, Central Nicobars.

This was introduced into the Nicobars from Port Blair, and is quite common at Trinkut and Camorta and, though not specifically noted, probably at Nancowry too. There is no evidence of its occurrence anywhere else on the Nicobars.

1142. **Hypsipetes nicobariensis** Moore (Nicobars) Nicobar Bulbul.

7 ♂♂, 2 ♀♀ Trinkut, Camorta, Nancowry, and Katchal, Central Nicobars.

Hume (1874) has contrary reports regarding its being seen on Great Nicobar on pages 75 and 223 and may best be completely ignored. The species appears restricted to the Central Nicobars where it was quite common.

1402. **Rhinomyias brunneata nicobarica** Richmond (Great Nicobar). Olive Flycatcher.

2 ♀♀ Campbell Bay, Great Nicobar. ZOOL. SURVEY : 1 ♂, 4 ♀♀, 1 o? Great Nicobar.

Several were seen in forest at Campbell Bay, keeping usually to within 10 feet of the ground. The call is very similar to the opening portion of that of the Spotted Fantail Flycatcher (*Rhipidura albogularis*), but without the ending ' *to-tea, to-tea, to-tea.*'

This bird is not known to occur north of Little Nicobar.

B.N.H.S. Sp. No. 22569 has an irregular patch of white on the upper back.

1407. **Muscicapa latirostris** Raffles (Sumatra). Brown Flycatcher.

2 ♀♀ Car Nicobar ; 1 o ? Camorta, Central Nicobars.

We had noted it as common in the Andamans, but the present specimens appear to be the only records for the Nicobars.

1464. **Terpsiphone paradisi nicobarica** Oates (Nicobars) Paradise Flycatcher.

2 ♂♂, 2 ♀♀, 1 o ? Trinkut and Camorta, Central Nicobars. ZOOL. SURVEY : 2 ♂♂ (long-tailed white) Great Nicobar. U. S. NAT. MUS. : 6 ♂♂ Trinkut, Camorta, Nancowry, and Katchal, Central Nicobars. 2 ♂♂ Great Nicobar (long-tailed white) ; 3 ♀♀ Katchal, Central Nicobars.

Oates's race *nicobarica* is generally accepted as occurring in both the Andaman and the Nicobar Islands. Except for ' the tail of an adult male [white ? H.A.] in the possession of Captain Bridge who shot it on Mount Harriet, South Andaman ' (Davison *in* Hume 1874 : 216) and Butler's (1899 : 401) statement that he saw it only twice in eight months, I cannot trace any records of this species from the Andamans.

Butler said that in the Nicobars, he did not see any white adult male but young birds were fairly numerous ; he, however, did not visit Great Nicobar.

The fourteen from the Central Nicobars include 8 males (2 with gonads in breeding condition) but none of them are white nor do they have lengthened tails, while the 4 from Great Nicobar are all white.[1]

In the white phase, the upperparts are not pure white but have fine streaks of black and the tail feathers, as in Burmese birds, are broadly edged with black and the shafts of the longer feathers are black almost along their whole length, with a longer gap of white in the Burmese specimens available. Richmond (loc. cit.) said they differed from the corresponding phase of *T. affinis* only in the central tail feathers, ' which are much broader near the tips'. This character does not appear to be very satisfactory and, in the absence of a suitable range of specimens from Burma, it is not possible to comment further. The black-chinned males (6) from Central Nicobars have their tails 93-106 mm., while those with grey chins and the females have them smaller, 82-88.

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[1] Inquiry at the British Museum (D. Goodwin) reveals that they have one "all-white longtailed" male each from South Andamans and Great Nicobar, and two "short-tailed chestnut" birds from Camorta, Central Nicobars.

With the material and literature available, it is not possible to say whether there are one or more races resident in the Andamans and Nicobars, nor have we seen any definite evidence suggesting that any of the migrant forms visit the islands. It appears probable that the birds in the Andamans are non-breeding migrants while those from the Central Nicobars are resident and lack a white phase. The white males from Great Nicobar, either migrant or resident, are different. I have not examined any from Car Nicobar, where they presumably occur.

1468. **Monarcha azurea idiochora** (Oberholser) (Car Nicobar) Blacknaped Flycatcher. Car Nicobarese : *Kalong Tesa.*

2 ♀♀ Car Nicobar (collected in 1964). U. S. NAT. MUS. : 1 ♂, 1 ♀ Car Nicobar.

They are as large as *M. a. tytleri* (Beavan) from the Andamans, but have white on the lower underparts.

1469. **Monarcha azurea nicobarica** (Bianchi) (Nancowry, Central Nicobars) Blacknaped Flycatcher.

1 ♂, 2 oo ? Central Nicobars ; 4 ♂♂, 1 ♀ Campbell Bay, Great Nicobar. ZOOL. SURVEY : 2 ♂♂, 3 ♀♀ Great Nicobar. U. S. NAT. MUS. : 3 ♂♂, 4 ♀♀ Nancowry, Camorta, Tillangchong, Central Nicobars ; 4 ♂♂ Great Nicobar.

The Blacknaped Flycatcher was not uncommon in forested areas, keeping within 15 feet of the ground.

The 33 specimens from the Andamans and Nicobars measure :

	Wing	*Tail*	*Wing*	*Tail*
Andamans	3 ♂♂ 71-75 av.73	70-73 av.71·3	2 ♀♀ 72-73 av.72·5	69-72 av.70·5
Car Nicobar	1 ♂ 76	72	3 ♀♀ 72-77 av.74·6	68-70 av.69
Central Nicobars	5 ♂♂ 67-73 av.70·3	69-78 av.72·3	5 ♀♀ 65-70 av.67·8	60-67 av.63·6
Great Nicobar	10 ♂♂ 63-70 av.66·3	56-67 av.65·1	4 ♀♀ 66-67 av.63·5	57-62 av.60·7

The birds from the Andamans (*tytleri*) and Car Nicobar (*idiochora*) are well separable while those from Central and Great Nicobars have been accepted as *nicobarica*. From the material available it would appear that the decline in size from Car Nicobar to Central Nicobars continues southwards, to Great Nicobar. In addition to this slightly smaller size, the Great Nicobar females differ in (a) being browner and less grey above, (b) the blue of the head which is darker is distinct from the upper back and does not grade into it. The Great Nicobar males are in colour more like *tytleri*, except for the white axillaries, and more white on the underparts.

Without access to relevant literature and specimens from east and south, I cannot now separate them.

In the SYNOPSIS, Ripley omits Stuart Baker's race *sykesii* (Type locality : Deccan) and has the Chinese race *styani* extending over the whole of India. While examining the Nicobar birds I had occasion to look at Indian and Burmese specimens and found that 14 females from peninsular India are greyish above as against 10 brownish from Assam and Burma, only 4 being indeterminate. The males from south India and Burma are also a deeper blue compared with those from Gujarat, Berar, Hyderabad, and Kanker. This matter needs to be re-examined with larger series from more places.

1500a. **Cisticola juncidis malaya** Lynes (Klang, Selangor, Malay State) Fantail Warbler.

1 ♂ Car Nicobar (1964) ; 3 ♂♂, 2 ♀♀, 2 oo ? Trinkut and Camorta, Central Nicobars.

This bird was not uncommon in grassy areas. The Car Nicobar bird was identified as *malaya* by Dr. Ripley, and the others from the Central Nicobars appear to be the same. The FAUNA (**2** : 423) states that the young are like the adults but with very yellow underparts. Two juveniles (1 ♂, 1 ♀) collected at Camorta show much more yellow around the chin and breast than in any specimens available from India, and have prominent streaks on the head. Such streaking is present in the juveniles and a female, but is absent in 3 males and indistinct in the fourth, all collected at about the same season.

Abbott & Kloss have a sight record of a *Cisticola* presumably of this kind, from Great Nicobar.

( ). **Locustella certhiola** subsp.

Both races *centralasiae* Sushkin and *rubescens* Blyth are said to occur in the Andamans (Ripley 1962 : 462). Abbott & Kloss obtained one at Camorta, Central Nicobars, but the race is not mentioned.

1544. **Locustella lanceolata** (Temminck) (Russia) Streaked Grasshopper Warbler.

1 o ? Trinkut, 1 o ? Camorta, 1 ♂ Nancowry, Central Nicobars.

This warbler was first met in open grass-land on Trinkut Island, while looking for the Blue-breasted Quail. When flushed it would fly low over the grass and drop in without settling in view. I do not recollect a greater skulker and one, not rare, but so difficult to secure.

Compared with three from the Andamans at the British Museum (N.H.) they are slightly larger :

	Wings	*Tails*
Andamans	50 (2)-51	32-39
Central Nicobars	54-55	39-42

All were collected between December and April and are slightly smaller than the measurements in the HANDBOOK OF BRITISH BIRDS (**2** : 40) wings 53-59, tails 42-50.

This species does not appear to have been recorded from the Nicobars before. Is it a winter visitor?

Incidentally, I have accepted the type locality as Russia (as in the HANDBOOK, loc. cit.), because 'Mainz?' as in the FAUNA and the SYNOPSIS, though mentioned in the original description, was at the same time said to be erroneous (See Ticehurst, *J. Bombay nat. Hist. Soc.* **31** : 497).

1549. **Phragamaticola aedon aedon** (Pallas) (Dauria) Thickbilled Warbler.

We did not meet this bird in the Nicobars but Davison and others noted it as not uncommon in the Andamans (where we had obtained one) and Davison obtained 18 specimens. They said it was rare in the Nicobars, obtaining one at Camorta and seeing others on Tillangchong. It is accepted as a cold weather visitor to this area.

( ). **Phylloscopus tenellipes** (Swinhoe) (Amoy) Palelegged Leaf Warbler.

I have nothing to add to the single record of a specimen captured on a boat 10 miles east of Great Nicobar, which is not mentioned in the SYNOPSIS.

1726. **Monticola solitaria pandoo** (Sykes) (Ghauts, Dukhun) Blue Rock Thrush.

A young male obtained at Car Nicobar by Von Pelzeln is the only record. Ripley (SYNOPSIS) states that the race needs confirmation.

1736. **Zoothera citrina albogularis** (Blyth) (Nicobars) Orangeheaded Ground Thrush.

3 ♂♂, 1 o? Camorta and Nancowry, Central Nicobars; 1 o? Car Nicobar.

The single bird from Car Nicobar has a slightly paler head than the others and also less white on the chin. None have the olive green wash on the upper back as in the Andaman bird (*andamanensis*), in which the single specimen available has a rufous chin.

1864. **Anthus cervinus** (Pallas) (Siberia) Redthroated Pipit.

Hume and Davison (1875 : 242) recorded it from the Andamans and Nicobars, and stated that in the latter it had only been observed on Camorta, Central Nicobars.

1875. **Motacilla flava thunbergi** Billberg (Lapland) Greyheaded Yellow Wagtail.

1 ♀ Camorta, Central Nicobars.

? 1876. **Motacilla flava beema** (Sykes) Blueheaded Yellow Wagtail.

1 ♂, 1 o? Trinkut, Central Nicobars.

This species was quite frequently seen in the Central Nicobars. Richmond has referred to 3 specimens from Trinkut as *M. flava* presumably meaning the nominate form. One obtained by me in the Andamans earlier was identified as *thunbergi* as is one of the present three. The other two (Nos. 22608 and 22609) appear to be *beema*, but I notice that Vaurie in THE BIRDS OF THE PALEARCTIC FAUNA has included the Andamans in the range of *M.f. simillima* Hartert which, though excluded in the SYNOPSIS, is mentioned among the wagtails ringed in Kerala (Sálim Ali 1963 *J. Bombay nat. Hist. Soc.* **60** : 412). I am not in a position to identify the specimens trinomially.

1884. **Motacilla caspica caspica** (Gmelin) (Caspian Sea) Grey Wagtail.

One was obtained at Car Nicobar on the last trip and the bird was occasionally seen on Great Nicobar.

*1888. **Motacilla alba leucopsis** Gould (India) White Wagtail.

Hume (1874 : 237) was unable to determine what race occurred in the Andamans, but I had overlooked the fact that he later (1876 : 291) identified a single specimen as of this race (=*luzoniensis* Scopoli) which is accepted in the SYNOPSIS.

1914. **Nectarinia jugularis klossi** (Richmond) (Great Nicobar).

3 ♂♂, 4 ♀♀ Nancowry and Trinkut, Central Nicobars (including 2 collected in 1964)
1 ♂, 1 ♀ Campbell Bay, Great Nicobar. ZOOL. SURVEY : 1 ♀ Great Nicobar.

Boden Kloss [Richmond 1903 : 298 (wrongly printed in my paper as 133)] refers to this bird as common at most camps and also saw nests suspended from mangroves overhanging creeks. In the original description, birds from Car Nicobar, Trinkut and Tillangchong (Central Nicobars), and Great and Little Nicobars are said to be of this race. Including specimens at the British Museum (N.H.), birds from Kondal and Great Nicobar have their bills 20-21 mm. against 17-18 in birds from Nancowry, Trinkut, and Camorta but their wings and tails show no differences in size. It is possible that a well prepared series would permit the separation of these two groups.

Some of the males from Katchal, Camorta, and Kondal (at British Museum) have the metallic portion of the forehead followed by brown.

1915. **Nectarinia jugularis procelia** (Oberholser) (Car Nicobar) Yellow-breasted, or Olivebacked, Sunbird. Car Nicobarese : *Raycha.*

6 ♂♂, 1 ♀ Car Nicobar.

This bird was quite common at Car Nicobar and more easily visible than further south due to the opener nature of the forest. The bills 15·5-16·5 mm. are noticeably smaller than in any from further south.

1929a. **Aethopyga siparaja nicobarica** Hume (Kondal) Yellowbacked Sunbird.

4 ♂♂, 1 ♀ Great Nicobar. ZOOL. SURVEY : 1 ♀ Great Nicobar.

On Great Nicobar this species was often seen. It is restricted to the southern islands of Kondal, Meree, and Little and Great Nicobars. The females have slightly smaller wings than the males.

1936. **Zosterops palpebrosa nicobarica** Blyth (Nicobar Islands)White-eye.

2 ♂♂, 2 oo ? (2 in 1964) ; 2 ♂♂, 1 ♀, 1 o ? Trinkut and Nancowry, Central Nicobars. U.S. NAT. MUS. : 4 ♂♂, 1 ♀, 1 o ? Barren Island ; 1 ♂, 1 ♀, 1 o ? South Andamans ; 2 ♂♂, 2 ♀♀, 1 o ? Car Nicobar ; 1 o ? Trinkut, Central Nicobars.

All the specimens are less yellow and greener above than Indian birds, and also have larger bills and shorter tails. No. 22897 a male collected at Nancowry on 13 March 1966 has a yellow stripe running down the middle of the breast, and connecting the yellow chin with the similarly coloured vent, and which is presumably the character on which Richmond separated *ventralis*, now synonymized with *nicobarica*. Birds from Southern Burma (Tavoy) have been separated by Hume as *auriventer* for this character, which is hardly noticeable in any of the Indian specimens available.

In series, the Andaman and Barren Island birds are paler above and have yellower rumps and heavier bills than those from Car and Central Nicobars.

This bird has not been recorded from Great Nicobar and the adjacent islands.

1970. **Lonchura striata semistriata** (Hume) (Nicobar Islands). White-backed Munia.

2 ♂♂, 1 ♀, 1 o ? Camorta, Central Nicobars.

White-backed Munias were quite frequently seen in suitable country in Car and Central Nicobars. The pale tipped feathers of the upper breast are similar to the immature plumage of the Andaman race—*fumigata* (Walden).

2046. **Emberiza aureola aureola** Pallas (Irtysh River, Siberia) Yellow-breasted Bunting.

Except for Hume's (1874 : 258) reference to a single bird (out of a flock of about 20) blown to pieces by Davison, there is no other record.

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[1] Not seen in original.

Contribution to the Flora of north-east Rajasthan[1]

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(*With a map*)

INTRODUCTION

Rajasthan, one of the largest states of the Indian Union, includes arid and semi-arid areas in the western, north-western, eastern, and north-eastern regions. Information as to the ecological status of the vegetation in different parts of Rajasthan is fragmentary. There is no complete published account of the flora of this region. Therefore, any contribution to the study of the vegetation of this area is of interest and importance.

A striking geological feature of Rajasthan is the presence of the Aravalli Range. This mountain chain divides Rajasthan into two regions, eastern and western. The eastern half is rich in vegetation, the western is unproductive and barren. Eastern Rajasthan is important geographically since it is close to Uttar Pradesh, Delhi and Madhya Pradesh. So, an investigation into its vegetation is bound to reveal some interesting facts as to the phytogeographical and geological status of Rajasthan, an aspect which seems to be unsettled so far (Wadia 1944).

Contributions to the vegetation of north-east Rajasthan have been made by Mulay & Ratnam 1950 ; Ramachandran 1950 ; Ratnam 1951 ; Bakshi 1954 ; Nair 1956 ; Nair & Nathawat 1956, 1957 ; Joshi 1958 ; Sharma 1958 ; Nair & Kanodia 1959 ; Nair 1961 ; Sarup 1961 ; Mulay & Mathur 1961 ; Nair, Kanodia, & Thomas 1961 ; and Vyas 1962. These studies include areas like Pilani, Lohargal, Chirawa, Harshnath, Jaipur, Ajmer, Ajit Sagar, Jhunjhunu, Bharatpur, Tonk, Khetari, and Jai Samand—Alwar.

AREA OF STUDY

For the present ecological survey the area selected is Alwar District, situated in the north-east of Rajasthan between latitudes 27° 5′ and 28°

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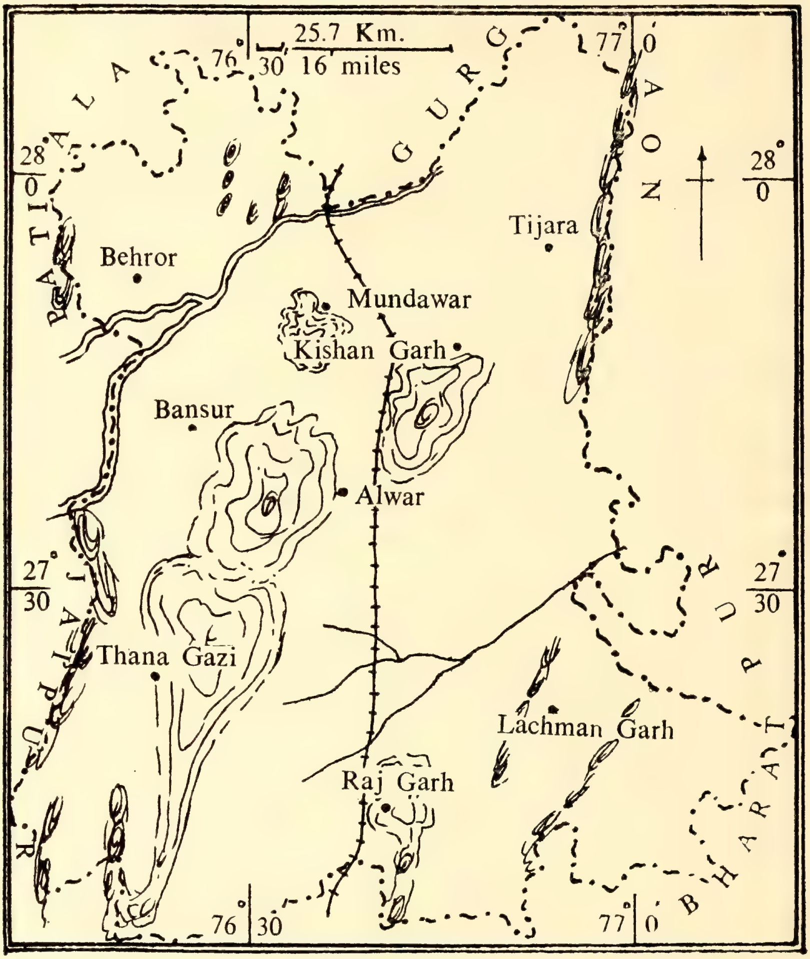
[1] A part of a thesis approved for the Ph.D. degree by the University of Rajasthan.

10′ N. and longitudes 76° 10′ and 77° 15′ E. at a height of 283 m. above m.s.l. It is bounded by the districts of Gurgaon in the north, Gurgaon and Bharatpur in the east, Jaipur in the south, and Jaipur and Patiala in the west.


25.7 Km.
16 miles
76° 30
77° 0
28° 0
27° 30
PATIALA
GURGAON
BHARATPUR
JAIPUR
Behror
Tijara
Mundawar
Kishan Garh
Bansur
Alwar
Thana Gazi
Lachman Garh
Raj Garh

Maps showing general topography of the area surveyed

The most important topographical feature in Alwar District is the occurrence of long ridges of hills which run as a rule parallel to each other from north or north-east to south or south-west. Their height in some places goes above 760 m. The country is fairly open towards the north-west and south-east with flat plains which lie between 300 and 400 m. above m.s.l. The chief rivers are the Sabi and the Ruparel.

The spots for the present study were selected so as to include a variety of ecological habitats, such as hill-tops and slopes, alluvial and sandy plains, river beds and water reservoirs and moist banks of such bunds. The places taken into account are Alwar proper, Vijay Sagar, Jai Samand, Pratap Bund, Bhura Sidh, Adapara, Hansarovar, Siliserh, Naldeswar, Kalighati, Pandopol, sandy areas of Behror and Tijara and the rivers Sabi and Ruparel.

CLIMATE

The climate is in general of the semi-arid type. The general average annual rainfall is about 667 mm. distributed over 36 rainy days. An interesting point observed is that the rainfall and the number of rainy days have been slowly increasing. The average annual rainfall for the five years 1956-1960, the period of this study, comes to 830 mm. distributed over 42 rainy days. The mean annual temperature is about 32·6° C. The monthly mean maximum temperature varies between 20·3°C. in January and 44° C. in May. The mean minimum temperature varies from 6° C. in January to 31° C. in June. *Loo* (hot wind) is prevalent during the summer, in the greater part of May and June.

GEOLOGY AND SOILS

The hill ranges in Alwar belong to two great systems, the Aravalli and the Delhi. Both these systems of rocks are of metamorphic nature consisting of mica schists, quartzites, limestones and sandstones.

The physical and chemical characteristics of the soils are the following :

1. Gravel soils occur on the hills ; sand, silt, or sandy loam in the plains ; and loam or clayey loam on the banks of water reservoirs.
2. The gravel and loamy soils are poor in carbonates and chlorides. They are rich in nitrates and have pH ranging from 6·5 to 7·5.
3. The sand and sandy loams are comparatively rich in carbonates and chlorides. These soils are poor in nitrates. The pH value reaches up to 8·5.
4. The humus content in the soil varies from season to season. It is maximum in the winter season. Its value decreases with depth.
5. The water content of the soil is low except in the rainy season.
6. River beds are characterized by soils with poor humus and porosity.

BIOTIC FACTORS

Excessive grazing, local agricultural practices, white ants, and desert locusts constitute the most important biotic factors affecting the vegetation at different phases of its development.

VEGETATIONAL ASPECT

The forests of Alwar fall under the category of deciduous forests of the dry Rajputana region. Without being a desert type, the vegetation is distinctly xerophytic in character. The forest cover is fairly dense during the monsoon months both in the understorey and the growth of the tops of the perennial species. There is an abrupt change in the face of the vegetation as soon as winter sets in, due to low temperature, soil drought, and increased adverse biotic activities. The hot season is the best for the flowering of woody species and the worst month is January. On the other hand, a large number of herbs and shrubs flower in the cold season.

VEGETATION ON THE HILLS

Although the hill-sides are excessively stony and seem bare of soil, they support an extraordinarily rich flora in both herbaceous and perennial species. The typical lithophytic species are arranged in three elevational zones : upper, middle, and lower. The upper zone is characterized by tree species like *Boswellia serrata* (d)[1], *Crataeva nurvala* (c), *Terminalia belerica* (f), *Holoptelea integrifolia* (o), *Mallotus philippensis* (r), and *Euphorbia neriifolia* (c). The middle zone is dominated by *Anogeissus pendula*. This species is associated with *Commiphora mukul* (f), *Lannea coromandelica* (r), *Butea monosperma* (f), *Wrightia tinctoria* (o), *Acacia catechu* (c), etc. In the basal zone are found *Tecomella undulata* (r), *Dichrostachys cinerea* (c), *Acacia arabica* (f), *Gymnosporia spinosa* (c), etc.

The common shrubs and undershrubs of such areas are *Grewia flavescens*, *Rhus mysorensis*, *Securinega leucopyrus*, *Randia tetrasperma*, *Vitex negundo*, *Helicteres isora*, and *Capparis sepiaria*.

The ground cover is fairly dense and does not show much effect of zonation. During the rainy season this type of vegetation includes species of *Tephrosia*, *Abutilon*, *Desmodium*, *Boerhavia*, *Leucas*, *Justicia*, *Sida*, *Ruellia*, *Glossocardia*, *Lindenbergia*, *Chloris*, *Heteropogon*, *Eragrostis*, etc. The herbaceous vegetation during the winter is comparatively poor and is represented by *Blainvillea acmella*, *Vicoa indica*, *Elytraria acaulis*, *Salvia aegyptiaca*, *Blumea napifolia*, *Solanum xanthocarpum*, *Dichanthium annulatum*, *Imperata cylindrica*, *Aristida depressa*, *Cynodon dactylon*, etc.

VEGETATION OF VALLEYS

The perennial species of open and exposed valleys are *Acacia arabica*, *Butea monosperma*, *Balanites aegyptiaca*, *Opuntia dillenii*, *Lycium euro-*

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[1] a=abundant ; c=common ; d=dominant ; f=frequent ; o=occasional ; r=rare.

paeum, Lantana camara, etc. The cool and shady valleys show a luxuriant growth of *Butea monosperma, Mitragyna parvifolia, Colebrookea oppositifolia, Dendrocalamus strictus*, and *Wrightia tomentosa.*

The characteristic herbaceous species of the shade are *Plumbago zeylanica, Ecbolium linneanum, Rungia parvifolia, Eranthemum nervosum*, and *Elytraria acaulis.*

VEGETATION OF THE SANDY PLAINS

The plains show a vegetation much poorer than that of the hills. The perennial species are *Prosopis spicigera*(a), *Capparis decidua*(a), *Acacia senegal*(c), *Acacia leucophloea*(c), *Acacia arabica*(a), *Salvadora oleoides*(r), *Balanites aegyptiaca*(c), *Zizyphus nummularia*(a), *Calotropis procera*(c), *Clerodendrum phlomidis*(c), and *Gymnosporia spinosa*(c).

The rainy season vegetation is characterized by annuals like *Tephrosia purpurea, Boerhavia diffusa, Cleome viscosa, Cleome gynandra, Trianthema triquetra, Crotolaria trifoliastrum, Farsetia jacquemontii, Digera muricata, Leucas mollissima*, and grasses like *Setaria glauca, Digitaria sanguinalis, Tetrapogon tenellus, Brachiaria ramosa*, and *Eragrostis pilosa.*

The common climbers and twiners are *Cocculus pendulus, Vallaris solanacea, Cryptostegia grandiflora, Vigna catjang, Ipomoea pes-tigridis*, etc.

The ephemeral vegetation generally does not continue beyond November. The disappearance of the rainy season annuals is made good by the winter annuals. The common species of this class are *Argemone mexicana, Fumaria indica, Fagonia cretica, Glinus lotoides, Echinops echinatus, Chenopodium album, Polygonum plebejum, Carthamus oxyacantha, Heliotropium eichwaldii*, and grasses like *Eragrostis ciliaris, Sprorobolus tremulus* and *Cymbopogon jwarancusa.*

VEGETATION OF RIVERSIDE AND TANK VICINITIES

Loamy plains are present on the banks of lakes and tanks. Water margins in the rainy season show a luxuriant growth of *Coldenia procumbens, Glinus lotoides, Eclipta prostrata, Borreria hispida, Bergia ammannioides, Cynodon dactylon, Acrachne racemosa, Scirpus supinus, Eleocharis geniculata*, and *Cyperus distans.*

As the water level recedes the perennials encroach deeper into the lake and wet meadow plants begin to grow. Such species are *Gnaphalium pulvinatum, Rumex dentatus, Ammania baccifera, Galium asperifolium, Fimbristylis squarrosa, Cyperus conglomeratus, Echinochloa crusgalli, Arthraxon lancifolius*, and *Eragrostis coarctata.*

During April and May this type of vegetation is dominated by *Argemone mexicana*, *Xanthium strumarium* and *Echinops echinatus*.

On the slopes of the lakes which are gravelly are found associations of *Saccharum bengalense*, *Sida grewioides*, *Zizyphus xylopyrus*, *Calotropis procera* and *Adhatoda vasica*.

VEGETATION OF MARSHES

In such areas there are pure stands of *Typha angustata*. On the banks of marshes are commonly found *Bacopa monnieri*, *Ammania baccifera*, *Phyla nodiflora*, *Limnophila heterophylla*, and *Cyperus eleusinoides*. In the puddles grow *Potamogeton nodosus*, *Hygrorhiza aristata*, *Marsilea minuta*, *Paspalum punctatum*, and *Chara* sp.

HYDROPHYTES

The common floating species are *Nymphoides indicum*, *Ipomoea aquatica*, *Lemna minor*, *Potamogeton perfoliatus*. The submerged species are *Hydrilla verticillata*, *Vallisneria spiralis*, *Utricularia stellaris*, *Ceratophyllum demersum*, and *Potamogeton pectinatus*.

WEEDS OF CULTIVATED FIELDS AND IRRIGATED GARDENS

This group includes *Cleome viscosa*, *Cleome gynandra*, *Physalis minima*, *Striga lutea*, *Digera muricata*, *Hibiscus lobatus*, and *Ipomoea hispida* as the weeds of kharif crop fields; *Fumaria indica*, *Melilotus indica*, *Solanum nigrum*, *Chenopodium album*, *Oligomeris glaucescens*, *Saponaria vaccaria*, *Asphodelus tenuifolius*, *Spergula pentandra*, etc. as the weeds of rabi crop fields ; and *Portulaca quadrifida*, *Oxalis repens*, *Anagallis arvensis*, *Verbascum thapsus*, *Withania somnifera*, and *Rungia parviflora* as the weeds of irrigated gardens.

ROADSIDE PLANTS

During the hot months the plants found along the roadsides are mostly hardy perennial shrubs and trees, introduced or indigenous to the area. Such species are *Prosopis juliflora*, *Albizzia lebbeck*, *Millingtonia hortensis*, *Melia azedarach*, *Tamarindus indica*, *Moringa pterygosperma*, *Emblica officinalis*, and several species of *Ficus*,

CRYPTOGAMS

The algal vegetation is fairly rich and is represented by a majority of Myxophyceae and Chlorophyceae. A number of parasitic fungi occur on both wild and cultivated plants.

The bryophytic and pteridophytic flora is mostly represented by *Riccia discolor*, *R. gangetica*, *R. plana*, *R. melanospora*, *R. billardieri*, *Cyathodium* sp., *Plagiochasma* sp., *Metzeria raddi*, *Funaria* sp., *Actinopteris dichotoma*, *Adiantum caudatum*, *Dryopteris parasitica*, *Equisetum debile*, and *Marsilea minuta*.

SYSTEMATIC ENUMERATION OF THE SPECIES

The following list of plants collected from the area has been arranged according to Bentham & Hooker's system of classification. Wherever possible, the vernacular name has been given. Every attempt has been made to bring the nomenclature up-to-date with the literature at the author's disposal. The numbers given after the plants refer to collections made by the author. Cultivated species have been marked with a single asterisk while roadside plants bear two asterisks.

ANNONACEAE

Annona squamosa Linn. A small tree. Rare. On hill slopes. Fls. March-May. (664)

***Polyalthia longifolia** Benth. & Hook. f. *Ashok*.

Miliusa tomentosa (Roxb.) J. Sinclair. A very rare tree at Naldeswar. On hill-top. (174)

MENISPERMACEAE

Cocculus hirsutus (Linn.) Diels. *Vajar Bel*. A climbing shrub. Common in valleys and lower parts of hills. Fls. Feb.-March. (170, 215)

C. cebatha DC. *Peelwar*. A common climber. Fls. Nov.-Dec. (665)

C. pendulus (Forst.) Diels. A common climber. Fls. April-May. (28, 307)

Tinospora cordifolia Miers. *Neem Gilol*. A climbing shrub. Rare; in valleys. Fls. April-May. (666)

Cissampelos pareira Linn. A tomentose climbing herb of open valleys. Rare. Fls. July-Oct. (516)

NYMPHAEACEAE

Nymphaea stellata Willd. A floating aquatic. Common. Fls. white; Aug.-Oct. (667)

Nelumbo nucifera Gaertn. Floating aquatic. Fls. rosy red. (668)

Euryale ferox Salisb. *Talmakhana.* A densely prickly aquatic. Fls. July-Aug. (651)

PAPAVERACEAE

Argemone mexicana Linn. A robust prickly herb. Very common. Fls. Jan.-May and Sept.-Oct. (232, 306)

FUMARIACEAE

Fumaria indica Pugsley A common weed of wheat fields. Fls. winter season. (485)

CRUCIFERAE

Farsetia jacquemontii Hook. *Kag pilong.* Common herb of sandy plains. Winter season. (328)

Sisymbrium irio Linn. Common herb of moist places. Winter season. (669)

Lepidium sativum Linn. A glabrous herb. Rare. On walls. (670)

Coronopus didymus (Linn.) Sm. Annual of most places. Fls. Dec.-Feb. (671)

CAPPARIDACEAE

Cleome viscosa Linn. Annual; Fl. yellow; July-Nov. in waste places. (45, 243A)

C. brachycarpa DC. *Navli.* Herb; rare; on hills. Fls. Nov.-May. (672)

C. papillosa Steud. Herb; rare; at foot of hills. Fls. Aug.-Oct. (673)

C. gynandra Linn. *Bagra.* A strong smelling herb. Common in sandy areas. Fls. July-Aug. (674)

Crataeva nurvala Buch.-Ham. *Barna.* Small tree; on hills. Fls. March-May. (5, 163)

Capparis spinosa Lamk. *Kabar*. A shrub of gravelly situations. Rare. Fls. May-July. (147, 149)

C. zeylanica Linn. non Hook. f. & Thom. A climbing shrub of valleys. Common. Fls. April-May. (675)

C. decidua (Forsk.) Pax. *Ker*. Much branched shrub. Common in plains. Fls. March-April. (676)

C. sepiaria Linn. Climbing shrub. Common in rocky areas. Fls. Feb.-April. (73, 115, 405)

Maerua arenaria Hook. f. & Thom. A perennial woody climber with leathery leaves. Rare. Fls. greenish-white ; Feb.-April. (492)

Cadaba farinosa Forsk. Unarmed straggling shrub of waste lands. Rare. Fls. Jan.-March. (677)

RESEDACEAE

Oligomeris glaucescens Camb. Annual. Common in fields and moist banks. Fls. greenish-white ; Feb.-April. (652)

FLACOURTIACEAE

Flacourtia indica (Burm. f.) Merr. A common tree of hills. Fls. March-April. (454)

POLYGALACEAE

Polygala erioptera DC. Annual. Common on sandy soils. Fls. Dec.-March. (481)

P. abyssinica Fresen. A common herb of plains. Fls. Oct.-Dec. (177, 184)

CARYOPHYLLACEAE

Polycarpaea corymbosa Lamk. Silvery panicled herb. Common. Fls. Aug.-Nov. (21)

Spergula arvensis Linn. Annual with linear subulate leaves in whorls. Fls. white ; Jan.-March. (678)

S. pentandra Linn. Annual with fleshy leaves. Common in fields. Fls. Jan.-March. (477)

Gypsophila alagines Biell. A herb of winter season. Common on moist banks. (104, 350)

Polycarpon prostratum (Forsk.) Asch. & Sch. Annual; on moist banks. Common. Fls. Jan.-March. (367)

Saponaria vaccaria Linn. A tall robust herb. Fls. white; Jan.-March in fields. (510)

Arenaria serpyllifolia Linn. Decumbent herb. Fls. white; Nov.-Jan. (576)

PORTULACACEAE

Portulaca oleracea Linn. Fleshy annual. Common in moist situations. Fls. Sept.-Dec. (679)

P. quadrifida Linn. Prostrate herb with long stipular hairs. Fls. Nov.-Jan. (680)

TAMARICACEAE

Tamarix aphylla (Linn.) Karst. A shrub or small tree of plains and riverside. Rare. Fls. pink. (681)

ELATINACEAE

Bergia ammannioides Heyne ex Roth. A common herb of moist banks. Fls. Oct.-Dec. (682)

MALVACEAE

Sida acuta Burm. f. Undershrub. Common on roadsides and waste places. Fls. yellow; Nov.-Jan. (500)

S. rhombifolia Linn. Erect undershrub. Common. Fls. Aug.-Dec. (556)

S. grewioides Guill. & Perr. *Kharenti*. An erect grey tomentose undershrub. Abundant in plains and bank of lakes. Fls. yellow; Oct.-Feb. (220, 507)

S. cordifolia Linn. A hairy undershrub. Common on roadsides. Fls. Aug.-Sept. (205, 461)

Abutilon indicum G. Don. A shrubby perennial up to 1·6 m. height. Common. Fls. March-Sept. (1, 195)

A. polyandrum Wt. & Arn. Pubescent annual of hill slopes. Fls. Nov.-Jan. (75)

Pavonia zeylanica Cav. A tall herb. Common at foot of hills. Fls. pink. (358, 359, 475)

Malvastrum coromandelianum (Linn.) Garcke. Erect herb. Common in cultivated and moist places. (60, 123, 555)

Kydia calycina Roxb. *Barong*. A moderate-sized tree of valleys and hill slopes. Fls. Sept.-Nov. (683)

Hibiscus lobatus (Murr.) O. Ktze. Erect annual of cultivated fields. Rare. Fls. Sept.-Nov. (559)

H. ficulneus Linn. A prickly herb. Common in cultivated fields. Fls. Sept.-Nov. (558)

BOMBACACEAE

Salmalia malabarica Sch. & Endl. A large tree. Common on lower zones of hills. Fls. Jan.-April. (292)

STERCULIACEAE

Melhania hamiltoniana Wall. A shrub of hill-top. Rare. Fls. Jan.-March. (362, 363)

M. tomentosa Stocks. A cano-tomentose branched shrub. Rare. Fls. Nov.-Dec. (16)

Sterculia urens Roxb. A moderate-sized tree of hills. Rare. Fls. Dec.-Feb. (684)

Helicteres isora Linn. Shrub of hills and valleys. Rare. Fls. Aug.-Oct. (569)

TILIACEAE

***Grewia oppositifolia** Roxb.

G. tenax (Forsk.) Fiori. *Gangera*. An erect shrub. Common. Fls. Aug.-Nov. (52, 178, 283)

***G. asiatica** Linn. *Phalsa*.

G. columnaris Sm. Much branched shrub. Rare on hill slopes. Fls. April-June. (112)

G. elastica Royle. *Dhaman*. Tree of valleys and hill-tops. Common. Fls. April-May. (685)

G. flavescens Juss. *Chaprend*. A common straggling shrub at hill base. Fls. July-Oct. (174)

Corchorus tridens Linn. Herb of rainy season. Common in plains. (43)

C. trilocularis Linn. *Kagle ki tambakoo*. Annual of waste grounds. Abundant. Fls. rainy season. (77, 78)

C. depressus (Linn.) Stocks. *Chamgas*. Woody herb of rainy season. Rare. (310)

Triumfetta cana Blume. Annual of rainy season, frequent in plains, (364)

T. bartramia Linn. Annual. Fls. yellow ; Aug.-Sept. (364A)

ZYGOPHYLLACEAE

Fagonia cretica Linn. A spiny herb or undershrub of winter season. Common on gravel. (288, 289)

Tribulus terrestris Linn. *Gokharu*. Annual prostrate hairy herb. Common in stabilized soils. Fls. yellow ; July-Sept. (193)

GERANIACEAE

Oxalis repens Thunb. Perennial herb of moist places. Fls. Oct.-May. (10)

***Averrhoa carambola** Linn.

RUTACEAE

Feronia limonia (Linn.) Swingle. Deciduous thorny tree. Rare on hills. Fls. Feb.-April. (686)

***Citrus aurantium** Linn. ***C. medica** var. **acida** Roxb. ***C. medica** var. **limetta** DC. ***Aegle marmelos** Correa. ***Murraya paniculata** (Linn.) Jack.

SIMAROUBACEAE

Balanites aegyptiaca (Linn.) Delile. *Hingot*. A small grey-green tree or small bush. Common on gravel and rare on hill-tops. Fls. Oct.-Dec. (403)

****Ailanthus excelsa** Roxb.

BURSERACEAE

Commiphora mukul (Hook. ex Stocks.) Engl. *Gugal*. Shrub or dwarf tree. Common. Fls. Oct.-Dec. (688)

Boswellia serrata Roxb. Deciduous tree. Dominant on upper zone of hills. Fls. Feb.-April. (689)

MELIACEAE

****Melia azedarach** Linn.

****Azadirachta indica** Juss.

Cedrela toona Roxb. Deciduous tree of high elevations. Fls. March-April. (690)

CELASTRACEAE

Gymnosporia spinosa (Forsk.) Fiori. Evergreen shrub or small tree. Common. Fls. Oct.-Feb. (284, 378, 521)

RHAMNACEAE

Zizyphus nummularia Wt. & Arn. Bushy shrub. Common. Fls. March-June. (688 A)

Z. xylopyra Willd. Straggling shrub. Abundant at the foot of hills. Fls. April-May. (692)

***Z. mauritiana** Lamk.

VITACEAE

Cayratia carnosa Gagnep. Herbaceous climber frequent in valleys. Fls. July-Sept. (489)

SAPINDACEAE

Cardiospermum halicacabum Linn. Herbaceous wiry climber. Frequent at foot of hills. (179, 213, 357)

Dodonaea viscosa Linn. Common hedge plant. Also as an escape in rocky areas. Fls. Oct.-Dec. (694)

Sapindus emarginata Vahl. Deciduous tree. Rare; on hills. Fls. Nov.-Jan. (540)

ANACARDIACEAE

Rhus mysorensis Heyne. *Dansaria*. Spiny shrub. Common in basal zone of hills. Fls. rainy season. (383, 482)

Lannea coromandelica (Houtt.) Merrill. Large tree. Rare; on hill slopes. Fls. March-May. (410)

***Mangifera indica** Linn.

MORINGACEAE

****Moringa oleifera** Lamk. *Saijana.*

LEGUMINOSAE

Crotolaria burhia Ham. Undershrub. Common in plains. Fls. winter season. (696)

***C. juncea** Linn. Cultivated. Also found as an escape.

C. procumbens Roxb. A diffuse perennial herb of rainy season. (788)

C. trifoliastrum Willd. Erect herb. Common in plains. Fls. rainy season. (212)

***Trigonella foenum-graceum** Linn.

T. occulta Delile. Annual of fields. Fls. Feb.-March. (463 & 654)

Melilotus alba Lamk. A herb of cultivated land. Fls. Jan.-March. (476)

M. indica All. A common weed of winter season in fields. (65)

Medicago denticulata Willd. Annual of winter season. Pods with spiny margin. (114, 119, 526)

Indigofera linnaei Ali. *Bhuiguli.* A much branched spreading annual. Fls. Aug.-Nov. Common in plains and grass lands. (138)

I. cordifolia Heyne. *Bechka.* Annual of loose soils and rock crevices. Fls. Sept.-Nov. (44, 57)

I. linifolia Retz. *Pandarphalli.* A prostrate herb. Common in moist places. Fls. Aug.-Oct. (346)

I. astragalina DC. Annual of rainy season. Common in plains. (785)

I. argentea (non Linn.) Burm. A low diffusely branched undershrub with yellowish flowers. Common in plains. (285)

***I. tinctoria** Linn. *Neel.* Also found as an escape. Fls. Sept.-Oct. (139)

I. trita Linn. f. Erect undershrub. Fls. Feb.-March. (655)

Tephrosia purpurea Pers. Sub-erect herb with several varieties. Abundant. Fls. Sept.-Jan. (12)

T. pauciflora Grah. Annual of plains. Rare. (230)

T. candida DC. A frequent annual of hills. (698)

T. strigosa (Dalz.) Santapau & Maheshwari. A slender caespitose herb with filiform stem. Fls. pink; Aug.-Oct. (786)

Sesbania sesban var. **picta** Santapau. Perennial soft-wooded shrub. Common in wastelands. Fls. Oct.-Dec. (169, 242, 259, 544)

Alhagi camelorum Fisch. *Javasa.* Erect thorny annual. Abundant at Hansarovar. Fls. April-June. (140, 141)

Alysicarpus monilifer DC. A slender, tufted, prostrate herb. Common in dry places. Fls. Sept.-Oct. (92)

Desmodium gangeticum DC. Undershrub. Common on hill slopes. Fls. May-July. (20, 269, 387)

D. triflorum DC. Trailing herb of plains. A good sand binder. Common. Fls. Sept.-Oct. (464)

Vicia sativa Linn. A sub-erect annual with angular stem. Fls. winter season. (699)

Abrus precatorius Linn. *Chirmi.* A woody twiner. Common. Fls. Aug.-Sept. (161)

Lathyrus aphaca Linn. A herbaceous climber of winter season. Rare. (67)

Mucuna prurita Hook. *Kauch.* Climber. Common in rocky areas. Fls. winter season. (700)

Erythrina variegata var. **orientalis** (Linn.) Merr. A tall prickly tree of hills. Fls. March-April. (287 & 653)

Butea monosperma (Lamk.) Taub. Deciduous tree. Abundant in valleys. Fls. March-April. (701)

***Phaseolus mungo** var. **radiatus** Linn.

P. aconitifolius Jacq.

Vigna cylindrica (Linn.) Skeels. A common twiner of plains. Fls. rainy season. (47)

Rhynchosia minima DC. A common twiner of open jungles. Fls. Aug.-Oct. (381, 414)

****Dalbergia sissoo** Roxb.

****D. paniculata** Wall.

Pongamia pinnata (Linn.) Pierre. *Karanj.* Small tree along river bed. Largely planted. Fls. March-April. (451)

***Pisum sativum** Linn.

***Cicer arietinum** Linn.

Cassia occidentalis Linn. Diffuse undershrub. Common in barren places and hill-tops. Fls. Jan.-March. (26, 256, 331)

C. tora Linn. *Takla.* Gregarious annual. Pod subtetragonous. Fls. Sept.-Oct. (172, 374)

***C. siamea** Lamk.

C. fistula Linn. A medium-sized tree on hill slopes. Fls. April-June. (99, 153)

C. auriculata Linn. *Aval.* A shrub. Common on roadsides. Occasional on hills. Fls. Jan.-July. (202)

Parkinsonia aculeata Linn. Introduced.

****Delonix regia** (Boj.) Raf.

***Tamarindus indica** Linn.

****Bauhinia variegata** Linn. *Kachnar.*

B. racemosa Lamk. *Zinza.* A small deciduous tree of hills and slopes. Fls. March-April. (702)

B. malabarica Roxb. *Apta.* A low bushy tree of hills. Fls. Aug.-Oct. (703)

Prosopis spicigera Linn. *Shemi.* A prickly tree of plains. Fls. Dec.-March. (275)

P. juliflora DC. A small evergreen tree, almost naturalized. (251, 268)

Dichrostachys cinerea (Linn.) Wt. & Arn. A tree common in lower parts of hills and slopes. The spikes red and yellow. Fls. most of the year. (247, 277, 300)

Mimosa hamata Willd. A prickly shrub. Common in low jungles. Fls. rainy season. (458)

Acacia catechu Willd. Small deciduous tree. Common on hill slopes. Fls. May-July. (704)

A. jacquemontii Benth. *Boli.* Deciduous tree of dry sandy soils. Fls. Feb.-May. (705)

A. arabica Willd. Common spiny tree. Fls. Aug.-Dec. (259, 348)

A. ferruginea DC. *Safed khair.* Middle-sized tree. Rare; on hills. Fls. March-April. (656)

A. senegal Willd. *Kumat.* Small tree. Spines hooked in three. Abundant; on hills. Fls. Aug.-Nov. (276)

A. leucophloea Willd. *Jhira.* Tree with long spines and terminal inflorescence. Abundant in valleys. Common on hill slopes and plains. Fls. Aug.-Nov. (415)

****Albizzia lebbeck** Benth. *Siras.*

A. odoratissima Benth. *Kala siras.* Tree without prickles and with violet pods. Occasional on the hill slopes. Fls. April-June. (271)

Pithecellobium dulce (Roxb.) Benth. Small tree with short straight stipular thorns. Pods curiously twisted. Fls. Feb.-March. (537)

ROSACEAE

Potentilla supina Linn. Prostrate herb. Common near water. Fls. Feb.-April. (167, 493)

P. desertorum Bunge. Erect herb. All parts covered with soft spreading hairs. Fls. Sunk amongst the uppermost leaves. (706)

***Rosa indica** Linn.

***Prunus communis** Linn.

COMBRETACEAE

Anogeissus pendula Edgew. *Dhauk.* A dominant tree of middle zone. Fls. Aug.-Oct. (707)

A. latifolia Wall. *Dhawara.* Tree frequent on hill slopes. Fls. May-June. (187)

A. sericea Brandis. Tree with silky pubescence. Fls. in globose heads. (708)

Terminalia belerica Roxb. Small deciduous tree of hills. Rare. Fls. April-June. (710)

T. arjuna Bedd. Tree. Rare. On hill-top. Fls. April-May. (709)

MYRTACEAE

***Psidium guajava** Linn.

***Syzygium cumini** (Linn.) Skeels.

***Eucalyptus** sp.

LYTHRACEAE

Ammania baccifera Linn. A decumbent winter herb of wet ground. Fls. red. (7, 261)

A. multiflora Roxb. Annual. Fls. in compound peduncled cymes ; Sept.-Nov. (787)

***Punica granatum** Linn.

***Lagerstroemia flosreginae** Retz.

***Lawsonia inermis** Linn.

Woodfordia fruticosa (Linn.) Kurz. *Chaprend.* An evergreen shrub of hills. Fls. brilliant red ; Feb.-April., frequent. (414)

TRAPACEAE

Trapa bispinosa Roxb. *Singhara.* A floating herb. Cultivated as well as wild. Fls. Sept.-Oct. (711)

CARICACEAE

***Carica papaya** Linn.

CUCURBITACEAE

Cucumis sativus Linn. A hispidly hairy climber of plains and hills. Fls. rainy season. (267)

C. trigonus Roxb. A procumbent trailing perennial. Fls. May. (578, 579)

Citrullus colocynthis Schrad. *Indrayan.* Scabrous herb of winter season. Common in plains. (712)

Momordica balsamina Linn. A common climber. Fls. Aug.-Jan. (389)

M. dioica Roxb. Climbing herb. Fls. yellow ; Sept.-Dec. (301, 486)

Melothria maderaspatena (Linn.) Cogn. Annual herb. Common on upper zone of hills. Fls. July-Sept. (304)

***Lagenaria** sp.

Cephalandra indica Naud. Climbing herb of rainy and winter season. Common. (342, 343)

Trichosanthes cucumerina Linn. *Jangli padvel.* Succulent climber. Common. Fls. white ; Aug.-Nov. (582, 583)

CACTACEAE

Opuntia dillenii Haw. A common shrub on gravel. Fls. Feb.-April. (713)

MOLLUGINACEAE

Trianthema portulacastrum Linn. Procumbent, succulent herb. Fls. red ; July-Sept. Common. (714)

T. decandra Linn. Annual, carpels two. Fls. white ; Dec.-Jan. (111)

T. triquetra Willd. ex Rottl. A diffuse much branched, common weed. Fls. Oct.-Nov. (266)

Glinus oppositifolius (Linn.) A. DC. Glabrous herb. Fls. greenish; Sept.-Oct. Very common. (66)

G. lotoides Linn. A stellate woolly herb of winter season. Abundant in plains and on banks of lakes. Fls. Feb.-April. (715)

Gisekia pharnaceoides Linn. Diffuse, succulent and glabrous herb of dry sandy places. Fls. April-Sept. (483)

UMBELLIFERAE

Psamogeton biternatum Edgew. Annual with umbels of silver pink flowers. Fls. Feb.-March. Rare. (716)

***Foeniculum vulgare** Mill. ***Coriandrum sativum** Linn. ***Trachyspermum ammi** (Linn.) Sprague. ***Cuminum cyminum** Linn. ***Daucus carota** Linn.

ALANGIACEAE

Alangium salvifolium (Linn. f.) Wang. Thorny tree. Prefers well-drained sides of nullahs, Common. Fls. Feb.-April. (576)

RUBIACEAE

Borreria hispida (Linn.) Schum. A hispid erect herb. Abundant near water. Fls. July-Oct. (185, 231, 474)

B. stricta (Linn. f.) Schum. Annual erect herb. Common near water. Fls. Oct.-Nov. (11)

Randia tetrasperma Benth. & Hook. f. Deciduous shrub of hills. Common. Fls. April-June. (657)

Morinda tinctoria var. **tomentosa** Hook. f. A middle-sized tree. Common on hill slopes. Fls. white ; Oct.-Jan. (717)

***Anthocephalus cadamba** Miq.

Mitragyna parvifolia (Roxb.) Korth. Tree common in lower and middle zone of hills. Fls. May-June. (406)

Oldenlandia umbellata Linn. A diffuse annual near water. Fls. Sept.-Dec. (545)

O. corymbosa Linn. Annual herb with white flowers. Aug.-Oct. (567A)

Galium asperifolium Wall. A pubescent herb near water. Fls. March-April. (560)

Adina cordifolia Hook. f. Small tree frequent in open dry jungles. (729A)

COMPOSITAE

Echinops echinatus Roxb. A much branched spreading rigid annual of winter season. Common on banks of bunds and in plains. Fls. April-June. (4, 243)

Eclipta prostrata Linn. Strigose slender herb. Abundant near water. Fls. white ; throughout the year. (186, 360)

Gnaphalium indicum Linn. Slender woolly herb with small flower heads in spikes. Common on dried up banks. Fls. Feb.-April. (63, 109)

G. pulvinatum Delile. Woolly herb on damp ground. Fls. winter season. (56)

Launaea nudicaulis Hook. f. Glabrous perennial with yellow flowers in winter season. (311, 536)

Tridax procumbens Linn. Straggling herb. Common. Fls. all the year round. (207)

Vicoa indica (Willd.) DC. Viscidly pubescent herb with orange yellow flowers ; Nov.-May. (508)

V. vestita Benth. Softly hairy herb with bright yellow heads. (191)

Vernonia cinerea Less. Erect herb of waste grounds. Fls. most of the year. (48, 297, 534)

V. cinerascens Sch. A pubescent shrub of waste grounds. Fls. Sept.-Nov. (565)

Xanthium strumarium Linn. Coarse shrub of waste grounds and river banks. Fls. Sept.-Oct. and Jan.-Feb. (24, 82, 204)

Artemisia scoparia Waldst. & Kitt. Erect tomentose herb. Frequent. Fls. yellow ; Sept.-Dec. (87)

Blainvillea acmella (Linn. f.) Philipson. Erect coarse herb. Common. Fls. Sept.-Jan. (371, 385)

Sonchus arvensis Linn. Tall perennial. Common on hills. Fls. Dec.-Jan. (718)

Blumea laciniata DC. Coarse aromatic erect herb. Common in open places. Fls. Jan.-Feb. (455)

B. amplectens DC. Annual of waste ground and river banks. Fls. yellow ; March-April. (564)

Glossocardia bosvallea (Linn. f.) DC. Erect annual. Common on rocks. Fls. Aug.-Oct. (535)

Carthamus oxyacantha Bieb. Spinose herb of winter season. Common in plains. Fls. yellow ; March-April. (553)

Grangea maderaspatana Poir. Procumbent weed of fields and wet grounds. Fls. Dec.-April. (562)

Anaphalis adnata DC. A stout herb with white woolly covering. (563)

Inula grandiflora Willd. A perennial. Rare. Fls. Nov.-Jan. (566)

Wedelia urticaefolia DC. A weak erect herb of wet places. Fls. Aug.-Sept. (719)

Bidens biternata (Lour.) Merr. & Sherff. Glabrous pilose tall herb. Fls. yellow ; Sept.-Dec. Common in damp places. (569)

Pulicaria crispa Schultz. Stout, shrubby perennial of waste places. Fls. Feb.-May. (720)

PLUMBAGINACEAE

Vogelia indica Gibs. An erect shrub. Rare. On rocks. Fls. Jan.-March. (551)

Plumbago zeylanica Linn. Subscandent perennial herb of shady places. Fls. July-Oct. (491, 504)

PRIMULACEAE

Anagallis arvensis Linn. Annual herb of plains. Fls. blue ; Feb.-March. (102, 103)

SAPOTACEAE

Achras sapota Linn. Tree, planted on hill-tops. Rare. Fls. April. (270)

Manilkara hexandra (Roxb.) Dub. *Khirni*. Small tree on hills. Rare. Fls. Nov.-Jan. (29)

***Mimusops elengi** Linn.

Madhuca indica Gmel. *Mahuwa*. Deciduous tree. Common in valleys. Fls. March-April. (721)

EBENACEAE

Diospyros melanoxylon Roxb. Small tree. Occasional on hill slopes. Fls. May. (658)

OLEACEAE

***Nyctanthes arbor-tristis** Linn. *Sihali*.

***Jasminum multiflorum** (Burm. f.) Andr.

SALVADORACEAE

Salvadora persica Linn. Small tree of plains. Frequent. Fls. Nov.-May. (336, 518)

S. oleoides Decne. Large shrub. Common in plains. Rare on hills. Fls. March-April. (71)

APOCYNACEAE

***Lochnera rosea** (Linn.) Reichb.

L. pusilla (Murr.) Schum. Erect annual with white flowers. Rare. Fls. rainy season. (723)

Wrightia tinctoria R. Br. Small deciduous tree. Common on hills. Fls. July-Sept. (79, 498)

W. tomentosa Roem. Tree frequent in valleys and damp places. Fls. May-June. (305, 325)

***Nerium indicum** Mill.

***Tabernaemontana coronaria** Br.

Vallaris solanacea (Rth.) O. Kuntze. *Rubār* A tall evergreen twining shrub of plains and valleys. Rare. Fls. Jan.-June. (550)

***Thevetia peruviana** (Pers.) K. Schum.

Holarrhena antidysenterica Wall. A shrub common in lower parts of hills. Fls. May-June. (724)

Plumeria rubra Linn. Cultivated. A small tree with crooked trunk and rough bark. Fls. Feb.-April. (494)

Ichnocarpus frutescens R. Br. Large rambling shrub. Common in moist places. Fls. Dec.-Feb. (502)

***Carissa congesta** Wight.

ASCLEPIADACEAE

Calotropis procera R. Br. Large shrub. Common in plains and open and waste ground. Rare on the base of hills. Fls. most of the year. (175)

Pergularia daemia (Forsk.) Chiov. Climber, common in plains and rare at the foot of hills. Fls. Oct.-Feb. (235, 347)

Leptadenia pyrotechnica (Forsk.) Decne. *Kheep*. Erect nearly leafless glabrous shrub of sandy plains. Rare. Fls. Oct.-Jan. (166)

Cryptostegia grandiflora R. Br. Woody climber. Common in plains. Fls. April-Sept. (725)

Cryptolepis buchanani R. & Schult. Twining shrub. Fls. pale greenish-yellow ; April-May. (513)

Sarcostemma acidum (Roxb.) Voigt. Leafless jointed shrub on arid rocks. Rare. Fls. Sept.-Jan. (245A)

Oxystelma esculentum (Linn. f) R. Br. A slender climbing perennial near water at Tijara. Fls. Sept.-Nov. (788)

GENTIANACEAE

Nymphoides indicum (Linn.) O. Kuntze. Floating aquatic. Common. Fls. March-Oct. (511)

Enicostemma verticillatum (Linn.) Engl. Perennial glabrous herb. Common near water. Fls. Aug.-Nov. (62, 453)

BORAGINACEAE

Coldenia procumbens Linn. Annual hairy herb. Common near water. Fls. Aug.-Oct. (547)

Heliotropium supinum Linn. A villous annual. Common on hill slopes and banks of bunds. Fls. Feb.-March. (38, 128, 129)

H. strigosum Willd. Procumbent herb of dry pastures. Fls. all the year round. (459)

H. marifolium Retz. Decumbent herb. Fruits densely strigose. Fls. Oct.-Jan. (116, 152)

H. eichwaldii Steud. Erect herb. Branching from the base. Spikes helicoid. (523)

Trichodesma amplexicaule Roxb. Herb. Frequent. Fls. rainy season. (81)

T. indicum R. Br. Bulbous based hairy, herb with pale blue flowers. Rare. On rocks. Fls. Sept.-Jan. (726)

Cordia dichotoma Forst. f. Small tree. Common on gravelly soil. Fls. March-April. (522)

***C. rothii** R. & S. *Goondi.*

Ehretia laevis Roxb. Small deciduous tree on hill slopes. Fls. white; Feb.-April. (408)

CONVOLVULACEAE

Convolvulus arvensis Linn. Pubescent twining annual. Fls. pink; Dec.-Feb. (69, 499)

C. pluricaulis Chois. Diffuse, densely silky herb. Fls. pale rosy; July-Dec. Common in plains. (101, 194)

Cuscuta reflexa Roxb. Parasitic twining herb. Fls. Oct.-Dec. (208)

C. hyalina Roth. A parasitic herb on *Tephrosia*. (652 A)

Evolvulus alsinoides Linn. Diffuse villous perennial herb. Common. Fls. white or blue; July-Dec. (303, 380, 542)

Ipomoea coptica (Linn.) Roth apud R. & S. Prostrate annual herb with white flowers. Frequent. (121)

I. pes-tigridis Linn. Twining pubescent herb of plains. Fls. pale pink; rainy season. (206)

I. triquetra R. & S. Pubescent twining herb. Rare; in fields. Fls. rainy season. (282)

***I. cairica** (Linn.) Sweet.

I. aquatica Forsk. A floating plant of shallow pools. Common. Fls. Feb.-May. (479)

I. hispida (Vahl.) R. & S. Slender very hairy twining herb. Common in fields. Fls. Sept.-Oct. (570)

I. maxima (Linn. f.) Don. Perennial slender twining herb. Frequent. Fls. Aug.-Sept. (580)

Argyreia speciosa Sweet. Stout handsome climber. Fls. Aug.-Sept. (506)

Jacquemontia paniculata (Burm. f.) Hall. f. Slender pubescent twiner. Common on hills. Fls. March-April. (581)

SOLANACEAE

Datura innoxia Mill. Coarse shrub of waste land. Frequent in plains. Rare on hills. Fls. white; rainy and winter season. (196, 200)

Lycium europaeum Linn. Spiny shrub. Common on gravel. Fls. June-Nov. (233)

Solanum xanthocarpum Schrad. & Wendl. Spiny diffuse herb. Common in plains and waste lands. Rare. On hills. Fls. Dec.-June. (158, 159)

S. nigrum Linn. *Makoi.* A common weed of plains. Rare on hills. Fls. white; most of the year. (290, 291)

***S. melongena** Linn.

Withania somnifera Dunal. A perennial much branched herb or undershrub of waste lands. Fls. Oct.-May. (216)

***Nicotiana tabacum** Linn.

N. plumbaginifolia Viv. An occasional weed near water. Fls. white; April-May. (513)

***Lycopersicum esculentum** Miller.

***Cestrum nocturnum** Linn.

***Capsicum frutescens** Linn.

Physalis minima Linn. Herbaceous pubescent annual. Frequent in fields and near water. Fls. yellow; Nov.-Jan. (382)

SCROPHULARIACEAE

Verbascum thapsus Linn. Stellate tomentose herb. Rare. Fls. pale yellow; April-May. (150, 245)

V. chinense Sant. Annual herb, frequent in moist and shady places. Fls. yellow spurred; March-May. (265, 370, 496)

Striga gesneroides (Willd.) Vatke. Root parasite on *Euphorbia nivulia.* (728)

S. asiatica (Linn.) O. Kuntze. Slender parasitic herb on roots of *Pennisetum typhoideum.* (729)

Lindenbergia indica (Linn.) O. Kuntze. Glandular hairy annual. Frequent on crevices, old walls and moist banks. Fls. yellow; August-Nov. (388, 472)

L. machrostachya Benth. Small herb branching from root stock. Leaves reddish. Fls. rainy season. (176)

Bacopa monnieri (Linn.) Pennell. Succulent herb preferring swampy localities. Fls. April-June. (127, 294)

Kickxia ramosissima (Wall.) Janchen. Perennial herb of dry localities. Rare. Fls. April-June. (730)

Veronica anagallis Linn. Erect succulent herb of swamps. Frequent. Fls. pale pink ; March-April. (503, 557)

Limnophila heterophylla Benth. Common herb of swamps. Fls. Feb.-April. (520)

OROBANCHACEAE

Orobanche cernua Loeffl. Parasitic herb. Fls. winter season. (731)

Cistanche tubulosa Wight. Stout unbranched herb. Parasite on *Calotropis*. Fls. winter season. (732)

LENTIBULARIACEAE

Utricularia stellaris Linn f. Floating aquatic. Fls. winter season. (733)
U. flexuosa Vahl. A floating herb of winter season. (659)

BIGNONIACEAE

Tecomella undulata (Smith) Seem. Tree. Occasional on gravel. Fls. March-April. (404)

****Millingtonia hortensis** Linn.

****Kigelia pinnata** DC.

PEDALIACEAE

***Sesamum indicum** DC. Also found as an escape. (734)

Martynia annua Linn. Tall and stout shrub. Common on waste ground. Fls. rose coloured ; rainy season. Fruit characteristic. (131, 132)

Pedalium murex Linn. Weedy herb of gravel. Fls. Aug.-Oct. (309, 377)

ACANTHACEAE

Barleria prionitis Linn. Spiny and bushy undershrub. Frequent on gravel. Fls. yellow; Oct.-March. (41, 80)

B. acanthoides Vahl. Spiny herb. Common in plains. Fls. winter season. (734)

Dipteracanthus prostratus (Poir.) Nees. Undershrub. Rare; on old walls and moist shady places. Fls. rainy and winter season. (144, 460, 541)

D. patulus (Jacq.) Nees. *Katmora*. Small shrub of gravelly soil. Rare. Fls. Aug.-Nov. (246)

Ruellia tuberosa Linn. A frequent herb in gardens. Fls. deep blue; June-July. (734)

Rungia pectinata (Linn.) Nees. Small ramous weed of open grassy places. Fls. bluish-white; July-Sept. (660)

Ecbolium linneanum Kurz. Undershrub of moist and shady places. Rare. Fls. bluish-green; Oct.-Jan. (529)

Eranthemum nervosum (Vahl) R. Br. Shrub of shady places. Rare. Fls. blue; Jan.-March. (517)

Andrographis echioides Nees. Erect symmetrical herb on old walls and rocks. Rare. Fls. Aug.-Nov. (86, 505)

Lepidagathis hamiltoniana Wall. A spiny undershrub with spherical heads. Frequent at hill tops, slopes and waste lands. Fls. Dec.-Feb. (136)

Rostellularia procumbens (Linn.) Nees. Annual. Abundant on rocks. Fls. Aug.-Oct. (257)

Justicia diffusa Willd. Small herb of plains. Common. Fls. Aug.-Dec. (302)

Peristrophe bicalyculata Nees. A shrubby weed. Common. Fls. pink; Sept.-April. (190, 497)

Adhatoda vasica Nees. Evergreen gregarious shrub. Abundant at the foot of hills. Rare at hill top. Fls. most of the year. (239)

Blepharis maderaspatensis (Linn.) Heyne ex Roth. Prostrate herb of shady places and gravel soils. Rare. Fls. Aug.-Jan. (244A)

Elytraria acaulis (Linn. f.) Lindau. A shade loving plant on dried banks and gravelly soil. Fls. Oct.-Dec. (379)

VERBENACEAE

Clerodendrum phlomidis Linn. f. Large shrub at the foot of hills and slopes. Fls. Aug.-Feb. (264)

Stachytarpheta indica Vahl. Glabrous herb with blue flowers. Common at the foot of hills. Fls. Aug.-Nov. (373)

Gmelina arborea Roxb. An unarmed tree of slopes and cool valleys. Rare. Fls. March-April. (58)

Phyla nodiflora (Linn.) Greene. Prostrate herb with oblong heads. Abundant in marshy places. Fls. Oct.-Jan. (8, 258)

Lantana camara Linn. var. **aculeata** Mold. Erect evergreen shrub. Common on road sides. Rare on hills. Flowers throughout the year. (133)

Tectona grandis Linn. f. Tree only seen at Naldeswar. Fls. July-Sept. (17)

Vitex negundo Linn. Large evergreen shrub. Common at the base of hills. Fls. most of the year. (255, 409)

LABIATAE

Leucas lanata Benth. Herb common on hill slopes. Fls. Sept.-Dec. (37)

L. nutans Spreng. Diffuse herb. Fls. Nov.-Jan. (53)

L. cephalotes Spreng. Erect diffusely branched herb. Fls. white in dense globose heads ; Aug.-Nov. Frequent in fields and wastelands. (35, 68)

L. aspera Spreng. Annual with white flowers ; July-Nov. Common in plains. (735)

L. mollissima Wall. Weak tomentose herb. Rare. Fls. Aug.-Nov. (570)

L. montana Spreng. Soft, woolly herb of rocky jungles and waste grounds. Fls. Nov.-Dec. (604)

***Ocimum sanctum** Linn. *Tulsi.*

***O. basilicum** Linn. *Marva.*

O. americanum Linn. *Bapchi.* Erect slender herb. Common on hill slopes. Fls. Aug.-March. (54, 467)

Anisomeles indica (Linn.) O. Kuntze. Strong smelling pubescent herb. Fls. purple and bluish ; Sept.-Nov. (42, 49, 55)

Salvia aegyptiaca Linn. Herb or small undershrub of winter season. Rare. (88)

Colebrookea oppositifolia Sm. Large woolly shrub of valleys. Rare. Fls. Dec.-Feb. (407, 531)

Plectranthus rugosus Wall. Shrub of dry places and hill-tops. Fls. March-Oct. (168)

NYCTAGINACEAE

Boerhavia repens Linn. var. **diffusa.** Diffuse herb along path and on rocky grounds. Fls. pink ; rainy season. (6)

B. verticillata Poir. Decumbent sometimes climbing herb. Common in plains. (736)

***Bougainvillea spectabilis** Willd.

AMARANTHACEAE

Celosia argentea Linn. Erect glabrous herb. Common on high ground. Fls. pink ; Aug.-Dec. (89)

Digera muricata (Linn.) Mart. Slender annual. Common in plains. Fls. Sept.-Oct. (484)

Amaranthus spinosus Linn. Erect spiny shrub of wastelands. Fls. most of the year. (327)

A. gracilis Desk. Much branched slender herb. Common. Fls. Nov.-Feb. (738)

A. polygamus Linn. var. **angustifolius.** Prostrate weed. Common Fls. Nov.-Feb. (738)

Aerva javanica (Burm. f.) Spreng. Woolly herb. Rare ; in plains. (64)

A. sanguinolenta (Linn.) Blume. Straggling herb of rocky jungles. Frequent. Fls. Jan.-March. (539)

Pupalia lappacea (Linn.) Juss. Shade loving straggling undershrub of plains. Common. Fls. July-Dec. (15, 160)

Alternanthera sessilis (Linn.) R. Br. Annual in pure stands near water. Fls. Aug.-March. (23, 25)

Nothosaerva brachiata Wight. Slender annual with glistening white flowers. July-Sept. (739)

Achyranthes aspera Linn. Erect herb. Common. Fls. in terminal spike ; Sept.-Dec. (740)

A. bidentata Blume. Rambling herb of hills. Fls. rainy season. (741)

***Gomphrena globosa** Linn.

CHENOPODIACEAE

Chenopodium album Linn. Erect herb of winter in fields and wastelands. Common. Fls. in clusters forming panicled spikes ; Jan.-March. (340)

C. murale Linn. Foetid herb with flowers in dense cymes in axillary raceme. Aug.-Sept. (146, 533)

***Beta vulgaris** Linn. ***Spinacia oleracea** Linn.

POLYGONACEAE

Polygonum plebejum R. Br. Prostrate herb on dried banks. Abundant. Fls. pink ; Feb.-May. (189)

P. indicum Heyne. Annual with branches spreading all round. Frequent. Fls. Feb.-May. (742)

P. effusum Meissn. Slender herb of wet places. Common. Fls. pedicellate ; Feb.-May. (743)

P. barbatum Linn. Stout herb of marshes. Common. Fls. Oct.-Nov. (143)

P. glabrum Willd. Erect annual. Common on edges of tanks and water courses. Fls. pink ; Aug.-Nov. (142, 466)

Rumex dentatus Linn. Stout erect annual of damp places. Frequent. Fls. Feb.-March. (279)

***R. hastatus** D. Don. ***Antigonon leptopus** Hook.

ARISTOLOCHIACEAE

Aristolochia bracteata Retz. A weak prostrate glabrous herb. Occasional. Fls. Aug.-Oct. (238)

LAURACEAE

Cassytha filiformis Linn. A filiform leafless twining parasite on *Carrisa.* Fls. most of the year. (744)

PROTEACEAE

* **Grevillea robusta** A. Cunn.

EUPHORBIACEAE

Euphorbia microphylla Heyne ex Roth. Decumbent herb on hill slopes. Common. Fls. July-Nov. and Jan.-April. (226, 227)

E. **hirta** Linn. Annual clothed with yellow hair. Fls. throughout the year. (299)

E. **granulata** Forsk. Procumbent herb of plains and gravels. Fls. Sept.-Nov. (122)

E. **thymifolia** Linn. Small annual often with a pale coppery tinge. Fls. greater part of the year. (39)

E. **clarkeana** Hook. f. Prostrate herb. Common in fields. (745)

E. **nivulia** Buch.-Ham. Large shrub. Branches fleshy and cylindrical with pairs of sharp spines. Common on arid hills. Fls. Jan.-April. (746)

E. **neriifolia** Linn. Large branched shrub, abundant at upper zone of hills. Fls. Feb.-April. (747)

E. **dracunculoides** Lamk. Much branched, glabrous herb of plains and low hills. Fls. Sept.-Jan. (748)

E. **hypericifolia** Linn. Decumbent annual. Fls. all the year round. (749)

Phyllanthus niruri auct. Linn. Annual herb of cultivated places. Fls. yellowish ; Aug.-Sept. (750)

P. **maderaspatensis** Linn. Glabrous herb. Fls. Aug.-Sept. (46)

***Emblica officinalis** Gaertn. Cultivated as well as an escape.

Acalypha ciliata Forsk. Stout herb. Common. Fls. July-Oct. (94)

Ricinus communis Linn. An evergreen shrub. Cultivated as well as wild. Fls. Feb.-March. (751)

Putranjiva roxburghii Wall. Evergreen moderate-sized tree on hills. Frequent. Fls. March-May. (252, 490)

Securinega leucopyrus (Willd.) Muell.-Avg. Woody tortuous bush on base of hills. Fls. July-Aug. (488)

S. virosa (Roxb. ex Willd.) Pax & Hoffm. Deciduous small shrub of rocks. Rare. Fls. May-June. (501)

Mallotus philippinensis Muell.-Arg. Small evergreen tree of upper zone of hills. Rare. Fls. Oct.-Dec. (524)

ULMACEAE

Holoptelea integrifolia Planch. Large spreading deciduous tree. Abundant on high grounds and valleys. Fls. March-April. (752)

MORACEAE

***Morus alba** Linn.

URTICACEAE

***Ficus glomerata** Roxb. ***F. benghalensis** Linn. ***F. religiosa** Linn. ***F. carica** Linn. ***F. cordifolia** Roxb.

***F. tomentosa** Roxb. Small tree, on hill slopes. Frequent. Fls. Jan.-March. (754)

CERATOPHYLLACEAE

Ceratophyllum demersum Linn. A submerged aquatic herb. Common in still water. (753)

HYDROCHARITACEAE

Hydrilla verticillata (Linn. f.) Royle. Slender aquatic herb in running or still water. Fls. July-Sept. (755)

Vallisneria spiralis Linn. Submerged stemless herb, common. Fls. Jan.-May. (756)

SCITAMINEAE

***Canna indica** Linn. ***Zingiber officinale** Rosc. ***Musa sapientum** Linn.

AMARYLLIDACEAE

***Crinum asiaticum** Linn. ***Agave** sp.

DIOSCOREACEAE

***Dioscorea bulbifera** Linn.

LILIACEAE

Asparagus racemosus Willd. *Satawar*. Scandent spinous undershrub. Frequent; on hills. Fls. Sept.-Dec. (155, 156)

Asphodelus tenuifolius Cav. Annual herb in fields. Common. Fls. Feb.-May. (757)

Gloriosa superba Linn. Herbaceous climber of low jungles. Frequent at Pandopol, Naraini and near Sirska along roadsides. Fls. orange or crimson; rainy season. (661)

***Aloe barbadensis** Mill.

Scilla indica Baker. Small herb. Bulb ovoid. Rare; in hilly areas. Fls. greenish purple. July-Aug. (789)

PONTEDERIACEAE

Eichhornia crassipes Solms. Aquatic herb. Common in pools and puddles. Fls. blue; Feb.-April. (758)

COMMELINACEAE

Commelina benghalensis Linn. Creeping annual of damp and shady places. Fls. rainy season. (135)

C. obliqua Buch.-Ham. Stout 2-3 ft. tall herb of hills. Rare. (211, 468)

Cyanotis axillaris Schult. Glabrous sub-succulent creeping herb. Frequent. Fls. rainy season. (353 & 354)

PALMAE

Phoenix sylvestris Roxb. Tall Palm. Common in nullahs. Fls. May-June. (22)

PANDANACEAE

Pandanus tectorius Soland. ex Parkinson. Bushy shrub in swamps. Fls. rainy season. (759)

TYPHACEAE

Typha angustata Chaub. & Bory. A gigantic, gregarious, marsh plant. Abundant. Fls. July-Aug. (760)

ARACEAE

Pistia stratiotes Linn. Floating herb. Rare. (761)

LEMNACEAE

Lemna minor Linn. Floating aquatic. Very common. Fls. Aug.-Oct. (761A)

L. polyrrhiza Linn. Floating herb. Fronds dark green above, purplish below. Common. Fls. Sept.-Oct. (752A)

Wolffia arrhiza Wimm. Floating aquatic occurring as a green scum. Abundant in puddles. (501B)

NAIADACEAE

Potamogeton nodosus Poir. Floating herb. Common in lakes and puddles. Fls. Aug.-Jan. (519)

P. crispus Linn. Submerged aquatic herb. Fls. Dec.-April. (514)

P. perfoliatus Linn. Aquatic herb of streams. Fls. Jan.-March. Frequent. (556)

P. pectinatus Linn. Submerged aquatic with filiform stem. Abundant at Hansarovar. Fls. Nov.-Jan. (574)

CYPERACEAE

Scirpus corymbosus Heyne ex Roth (592). **S. articulatus** Linn. (83, 85). **S. supinus** Linn. (595). **S. maritimus** Linn. (597). **S. erectus** Poir.

(596). **Fimbristylis schoenoides** Vahl (593). **F. aestivalis** (Retz.) Vahl. var. **squarrosa** (Vahl) Koyama (552). **F. podocarpa** Nees (662). **F. dichotoma** Vahl (594). **Cyperus arenarius** Retz. (760). **C. distans** Linn. f. (591). **C. eleusinoides** Kunth (590). **C. haspan** Boeck. (589). **C. niveus** Retz. (588). **C. conglomeratus** Rottb. (587). **C. tuberosus** Rottb. (586). **C. iria** Linn. (585). **C. kyllinga** Endl. (601, 602). **Eleocharis geniculata** (Linn.) R. & S. (603). **Bulbostylis barbata** Kunth (599 and 600). **B. subspinescens** Clarke (598).

GRAMINEAE

Cenchrus ciliaris Linn. (788). **C. setigerus** Vahl (789). **Setaria glauca** Beauv. (398, 399). **Panicum psilopodium** Trin. (108 and 619). **P. maximum** Jacq. (761). **Paspalidium punctatum** (Burm. f.) A. Camus (614, 615). **Echinochloa crus-galli** (Linn.) Beauv. (95, 616). **E. colonum** (Linn.) Link (575). **Echinochloa** sp. (771). **Brachiaria kurzii** (Hook. f.) A. Camus (663). **B. ramosa** (Linn.) Stapf. (618). **Digitaria sanguinalis** (Linn.) Scop. (96, 106). **Eriochloa procera** (Retz.) C. E. Hubb. (392). **Paspalum distichum** Linn. (614, 615). **Imperata cylindrica** (Linn.) Beauv. (419, 622). **Saccharum arundinaceum** Retz. (769). **S. spontaneum** Linn. (770). **S. bengalense** Retz. (768). **Apluda mutica** Linn. (76, 624). **Arthraxon lancifolius** (Trin.) Hochst. (623). **Chrysopogon fulvus** (Spreng.) Chiov. (74, 396). **Sorghum halepense** (Linn.) Pers. (784). **Bothriochloa pertusa** (Linn.) A. Camus (417) **Dichanthium annulatum** (Forsk.) Stapf. (419). **Heteropogon contortus** (Linn.) Beauv. ex R. & S. (391). **Vetiveria** sp. (783). **Cymbopogon jwarancusa** (Jones) Schult. (781). **Aristida depressa** Retz. (776). **A. funiculata** Trin. ex Rupr. (628). **Perotis indica** (Linn.) O. Ktze. (394). **Sporobolus maderaspatanus** Bor (762). **S. diander** Beauv. (84, 620). **S. tremulus** (Willd.) Kunth. (621). **Polypogon** sp. (782) **Eragrostis ciliaris** (Linn.) R. Br. (766). **E. pilosa** Beauv. (610). **E. coarctata** Stapf (611). **E. tenella** (Linn.) Beauv. ex R. & S. (51, 14, 613). **Desmostachya bipinnata** (Linn.) Stapf. (416). **Melanocenchris jacquemontii** Jaub. & Spach. (777). **Cynodon dactylon** Pers. (767). **Tetrapogon villosus** Desf. (107). **T. tenellus** (Roxb.) Chiov. (763). **Chloris virgata** Sw. (400). **C. dolichostachya** Lag. (401, 402). **C. barbata** Sw. (765). **Schoenefeldia gracilis** Kunth. (764). **Eleusine indica** Gaertn. (775). **Dactyloctenium aegyptium** (Desf.) Beauv. (125, 395). **Acrachne racemosa** (Heyne) Ohwi. (393). **Hygrorhiza aristata** Nees ex Wt. & Arn. (773). **Dendrocalamus strictus** Nees (192).

STATISTICAL SYNOPSIS

The number and percentage of families, genera, and species in Dicotyledons and Monocotyledons are as follows :

	Dicotyledons		Monocotyledons		Total
	% of total	No.	% of total	No.	
Families	85	69	15	12	81
Genera	80·54	236	19·46	57	293
Species	78·36	344	21·04	95	439

The largest families having ten or more species are Scrophulariaceae (10), Capparidaceae (11), Malvaceae (11), Labiatae (11), Convolvulaceae (13), Amaranthaceae (14), Acanthaceae (16), Euphorbiaceae (17), Cyperaceae (21), Compositae (24), Leguminosae (51), and Gramineae (53).

The various genera are poorly represented. The largest genera having 5 or more species are *Polygonum* (5), *Scirpus* (5), *Indigofera* (6), *Ipomoea* (6), *Leucas* (6), *Acacia* (6), *Euphorbia* (9) and *Cyperus* (9).

Out of 439 species 68 are trees, 89 shrubs and undershrubs, and 282 herbs. Climbing plants are represented by 33 species ; *Cuscuta reflexa*, *Cuscuta hyalina*, *Striga asiatica*, *Striga gesneroides*, *Cassytha filiformis*, *Cistanche tubulosa*, and *Orobanche cernua* are parasites. *Utricularia stellaris* and *Utricularia flexuosa* represent carnivorous plants.

DISCUSSION

In recent years, the problem why plants grow in particular localities has attracted the attention of several plant ecologists. There are several contributions on the structure and dynamics of vegetation, in a process of change and being modified by modern civilization. It has been suggested by Billings (1952) that the vegetation of a given area can be used as an indicator of the total environment if the tolerance of characteristic species is known and if the vegetation is adequately analysed by statistical and floristic methods.

The arid and semi-arid tracts of Rajasthan support various integrated plant communities as shown by different workers. It is however felt that the information on the ecological status of the vegetation of different parts of Rajasthan is fragmentary. The phytogeographical and geological status of Rajasthan has been debated in recent years. The floristic composition of the area and its ecological status may be useful indices of its past, consequently the present study was designed to relate the vegetation with the environment and to understand the phytogeographical status of the area.

The environmental complex of the area from the view point of climate, soils, and biotic factors has been found to be adverse. The moisture content of the area is characterized by a considerably long period of water deficit due to low and irregular rainfall, high evapo-transpiration rates, and potential evapo-transpiration generally exceeding precipitation. This is further aggravated by adverse temperatures during the months of water deficit resulting in semi-arid to arid climate.

The corollary that the vegetation is an index of the environment may well be justified. The presence of sparse ground cover during the summer and winter months and of abundant ground cover during the rains the plant communities consisting of a few trees and shrubs and a large number of ephemerals, the deciduous nature of the forest tree species and the xerophytic adaptations like development of thorns, thickening of leaves, development of tomentum, white bark, etc. all suggest the semi-arid climate of the area.

It is possible to distinguish plant communities as affected by topography, soil nature, and available soil moisture, in addition to the adverse factors of the climate. The vegetation on the top of the hills consists of a few plant communities which seem to be controlled by the available soil moisture and exposure. The gentle slopes and the basal zone of hills support a richer vegetation due to better soil formation and increased water-holding capacity.

The soils on the hills and in the valleys are comparatively richer in humus and nitrate content which promotes the aggregation of soil particles and increases water-holding capacity. These soils are either neutral or slightly acidic and support a better vegetation, consisting of tree species. On the other hand, the soil of the plains is sandy with a low percentage of nitrates, and humus, and consequently of low water-holding capacity and alkaline in nature. It is, therefore, less favourable for the growth of trees and favours the growth of grasses and other herbs.

The flora is characterized by the complete absence of Guttiferales and Ericales, poor representation of Ranales, Carryophyllinae, Geraniales, Celastrales, Sapindales, Passiflorales, and Rubiales. The orders like Malvales, Parietales, Rosales, Myrtales, Gentianales, Polemoniales, Personales, Lamiales are well represented. Among Monochlamydeae, Amaranthaceae and Euphorbiaceae are very well represented.

The flora of this area has considerable similarity with that of the other investigated areas of north-eastern Rajasthan. The Table below gives the strength of dominant families and genera in the different investigated areas of this zone of Rajasthan.

TABLE SHOWING THE NUMBER OF SPECIES BELONGING TO DOMINANT FAMILIES AND GENERA IN VARIOUS INVESTIGATED AREAS OF NORTH-EAST RAJASTHAN

S. No.	Family or Genus	Alwar	Ajit Sagar	Chirawa	Harsh-nath	Lohargal	Pilani
	FAMILY						
1.	Gramineae	53	22	19	18	?	49
2.	Leguminosae	50	29	24	27	22	34
3.	Compositae	24	13	12	20	10	18
4.	Cyperaceae	21	8	3	4	?	5
5.	Euphorbiaceae	17	10	6	10	8	12
6.	Acanthaceae	16	10	2	8	10	8
7.	Amaranthaceae	14	10	8	11	6	8
8.	Convolvulaceae	13	8	4	7	3	8
9.	Malvaceae	11	10	3	6	6	11
10.	Capparidaceae	11	4	5	4	2	4
11.	Labiatae	11	6	3	5	8	6
12.	Tiliaceae	8	9	5	5	4	8
13.	Boraginaceae	9	9	3	8	4	9
14.	Scrophulariaceae	10	7	1	6	2	4
15.	Solanaceae	7	6	6	8	7	6
16.	Ficoidaceae	6	8	8	7	3	9
	GENUS						
1.	*Euphorbia*	9	6	2	5	3	5
2.	*Cyperus*	9	5	2	2	?	2
3.	*Indigofera*	6	5	3	8	2	5
4.	*Leucas*	6	4	2	3	1	3
5.	*Acacia*	6	3	5	4	2	5
6.	*Ipomoea*	6	4	1	3	1	3
7.	*Scirpus*	5	nil	1	1	?	1
8.	*Tephrosia*	4	7	1	2	3	5
9.	*Heliotropium*	4	5	3	4	1	6
10.	*Cassia*	4	3	5	2	3	4

It may be concluded that the flora of the investigated area approaches that of Mount Abu, the highest peak of the Aravallis. Species like *Flacourtia indica*, *Helicteres isora*, *Lannea coromandelica*, *Woodfordia fruticosa*, *Mitragyna parvifolia*, *Vogelia indica*, *Ehretia laevis*, and *Mallotus philippensis* growing in the present area have not been reported from any part of Rajasthan except Mount Abu.

In the flora of the investigated area three distinct elements, namely Perso-Arabic, Indo-Malayan, and General, can be distinguished. Of the three elements, the Perso-Arabic is represented by 164 species and the Indo-Malayan by 83 species. The Indo-Malayan element is thus half of the Perso-Arabic element.

In western Rajasthan, according to Blatter and Hallberg (1918-21) and Biswas and Rao (1953), the Indo-Malayan element is only one-seventh of the Perso-Arabic. In the flora of Ajit Sagar Bundh, eastern

Rajasthan, this proportion is a little more than one-third (Nair & Kanodia 1959), and in the flora of Harshnath, eastern Rajasthan (Nair & Nathawat 1957) this proportion is a little less than one half.

From the above data it is, therefore, clear that in the flora of Rajasthan, the Perso-Arabic element predominates over the Indo-Malayan element. The percentage of Indo-Malayan element increases as one proceeds from west to east. According to the suggestions of Drude (1890, 1913) supported by Blatter & Hallberg (1918-1921) and Biswas & Rao (1953), the line of demarcation between the Indo-Malayan flora and the Perso-Arabic flora ranges from the gulf of Cambay northwards along the Aravallis. If Drude's conclusions were correct, a place situated on the east of Aravallis should have a predominance of the Indo-Malayan element. On the contrary, the vegetation of the investigated area has a larger proportion of the Perso-Arabic element. It may, therefore, be suggested that a demarcation line should be sought more towards the east, even beyond the limits of Rajasthan.

SUMMARY

1. The present work is a contribution to the flora of north-east Rajasthan. The area of study is Alwar District.
2. The location and physiography of the area have been given.
3. The environmental factors affecting the vegetation have been discussed.
4. Statistical analysis of the flora indicates that there are 439 indigenous species belonging to 293 genera and 81 natural orders.
5. A comparative account reveals that the present area is the most complex in north-east Rajasthan and approaches that of Mount Abu the highest peak of the Aravalli range.
6. It is concluded that the vegetation of the investigated area is of semi-arid type and may be a deterioration product of a climatic climax vegetation.
7. Phytogeographical affinities lie mainly with the Perso-Arabic rather than with the Indo-Malayan regions.

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Middle East Lepidoptera—XXIV[1]: *Beihania,* a new Noctuid Genus from Southern Arabia with two new Species from Arabia and Somaliland

BY

E. P. WILTSHIRE, C.B.E., F.R.E.S.

(*With six text-figures*)

While revising *Armada* Staudinger, *Metoponrhis* Staudinger, and neighbouring genera, I came across a small group of moths occurring along the north-west shores of the Indian Ocean, one of which had been described as a *Metoponrhis.* A closer investigation shewed that this group has no close affinity with the *Armadini* and is best dealt with in a short, separate article, as follows.

Beihania gen. nov.

Type species :—*Metoponrhis anartoides* Warnecke 1937 (*Mitt. Münch Ent. Ges. J.* **27**, p. 47, Pl. 3, f.1.)

The superficial resemblance of this species to the rare and little known *Metoponrhis marginata* Hampson, described from Ceylon, seems the probable reason why the author included it in this genus. The frons without prominence, shorter palp, and genitalia of both sexes so different from those of *Metoponrhis* and *Armada* and the oval rather than elongate fore-wing areole shew it to be not at all closely related, though belonging, like those genera, to the rather ill-defined sub-family *Othreinae* (=*Noctuinae* Hampson and Warren-Seitz,=*Erebinae* Forbes).

The new genus may be provisionally placed near *Lyncestis* which it resembles superficially, but it is somewhat smaller than the type species, *Lyncestis amphix* Cramer, and its genitalia shew no affinity with that species. It is possible however that some other species at present standing under *Lyncestis* may prove to belong rather to *Beihania.*

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[1] The preceding articles in this taxonomic series, Nos. 21, 22 & 23, dealt with Afghan Geometridae and are appearing in Zeits.d.Wiener Ent. Ges. **51**, beginning with p. 29 (1966).

Beihania :

Palp, as long as diameter of eye, with very short third segment.

Antenna, of ♂, ciliated : of ♀, simple.

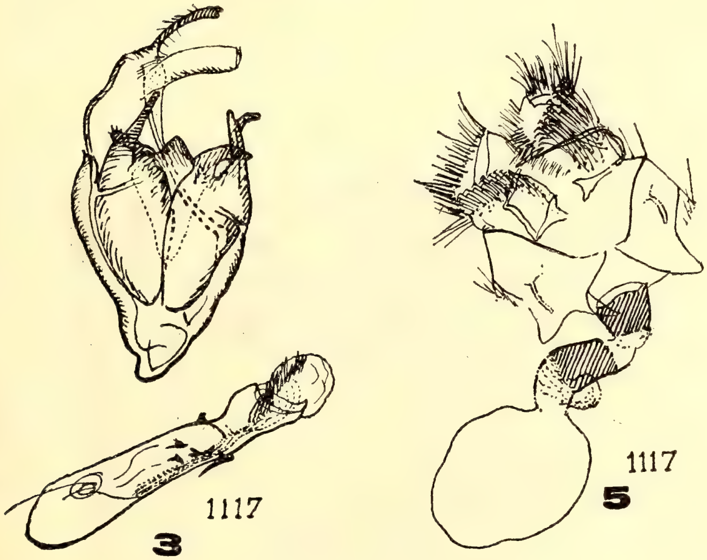
Frons, without prominence ; vertex, a low, scaled ridge.

Legs, spineless, short as in *Armada,* but hind-tibia even shorter and thickened.

Fore-wing, areole, oval ; neuration of both wings in other respects as in *Armada, Metoponrhis, Acrobyla,* etc.

Male genitalia : uncus, thickening distally, with hooked tip ; anus, a prominent sclerotised tube ; tegumen, symmetrical, long, sinuous ; valve, triangular, much shorter than aedeagus, very broad at base, with elaborate folded costa with two or three dorsal arms or fingers ; saccus, triangular ; aedeagus, long, massive at proximal end, with caecum thicker than tip.

Female genitalia : very different from those of *Metoponrhis, Armada,* etc. ; ovipositor-lobes, complex, with hairs and scales forming a floricomus ; posterior apophyses, quite long, inverted when not extended ; anterior apophyses, short, not rod-formed but in the form of udder-like lobes or pockets ; ductus, sclerotised, well-developed ; bursa, globular, comparatively small, but with a more or less developed distal appendix.



Beihania anartoides (Warnecke)
Fig 3. male genitalia, with aedeagus detached, ¾ ventral view ;
Fig. 5 female genitalia

Beihania anartoides (Warnecke)

Some structural details to amplify the original description and what has been said above :

Male genitalia (Fig. 3) : valve dorsal processes asymmetrical ; the upper dorsal finger on the right valve is bifurcate while that of the left is simple ; aedeagus with five moderate sized heavily chitined triangular cornuti and a field of about 20 finer spines.

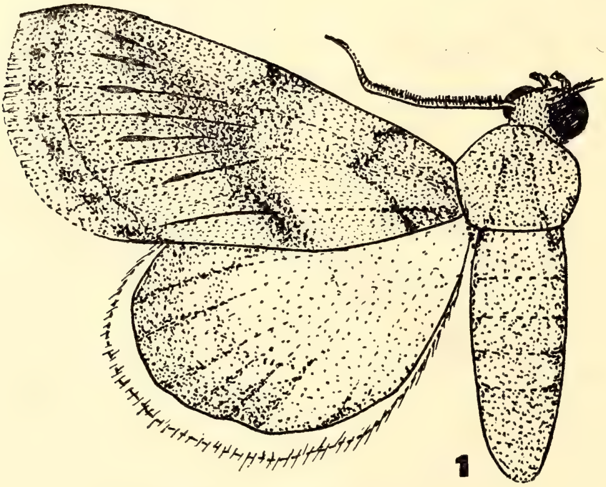
Female genitalia (Fig. 5) : ductus, in two sections, jointed, both sub-cylindrical, the posterior being wider at the ostium and the anterior wider at the entry to bursa, where there is a balloon-like densely spinose appendix. The true bursa is oval, not spinose and about twice as big as the appendix.

The above specific descriptions were made from examples :—

♂, (Prep. 1117) S.W. ARABIA, Beihan, iii. 52, leg. Popov, in coll. m.
♀, (Prep. 1117 L) S.W. ARABIA, Asir, Sabya, 10. iii. 45, leg. A. R. Waterston in coll. m.

Beihania cuculliella sp.nov. (Figs. 1 & 4)

Slightly larger than *anartoides*, paler grey, with hind-wing margin fainter-grey. Fore-wing, more elongated, lacking the black linear reniform stigma characteristic of *anartoides* ; ante-median and post-median fasciae, more clearly marked. Nervures, of fore-wing, infuscated in the marginal area to form black streaks ; fringe grey, chequered



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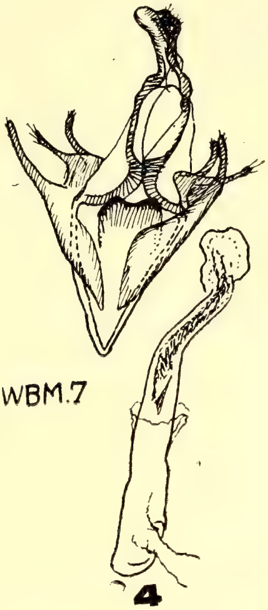
Beihania cuculliella sp. nov.

with black. Hind-wing nervures similarly but less infuscated, yet visible as they traverse the narrower, pale grey marginal band ; fringe, white.

Under-side, fore-wing, plain grey, the fringes chequered ; of hind-wing, as upper-side.



4

Beihania cuculliella sp. nov. male genitalia, with aedeagus detached, ventral view

Span :—23 mm. (cf. *anartoides*, 16-22 mm.)

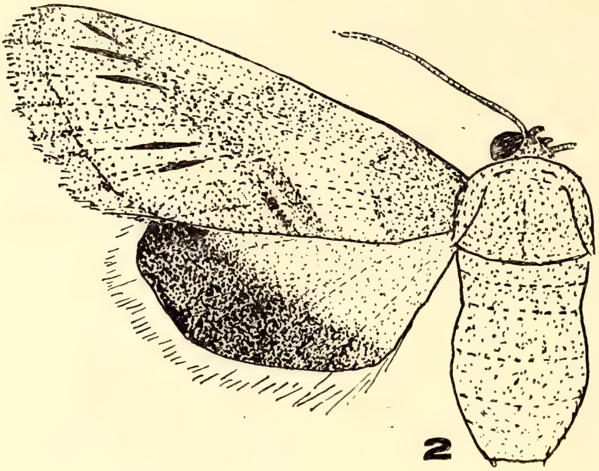
Male genitalia (Fig. 4) : uncus, shorter, thicker than *anartoides* ; valves, symmetrical, each with two tapering fingers springing from a fold at some distance from the tapering, finger-like tip of the valve ; aedeagus, with one large cornutus, and countless minute spines in two or three parallel series.

Holotype. ♂, Prep. B.M. Noct. 3370, ARABIA, Mecca, 8. iv. 32, leg. H. St. J. Philby, (in British Museum).

Paratypes. 6 other ♂♂, including Prep. WBM. 7, with same data ; also, 2 ♂♂, ARABIA, Wadi Baish, 7. vii. 36, leg. Philby ; 1 ♂, ARABIA, Suq Aiban, 20-21. xii. 36, & 1 ♂, Jidda, 17.iii.36, all leg. Philby ; also 1 ♂, ARABIA, Madraqa, 1. ii. 48, leg. A. R. Waterston ; all in British Museum.

Beihania hyatti sp.nov. (Figs. 2 & 6)

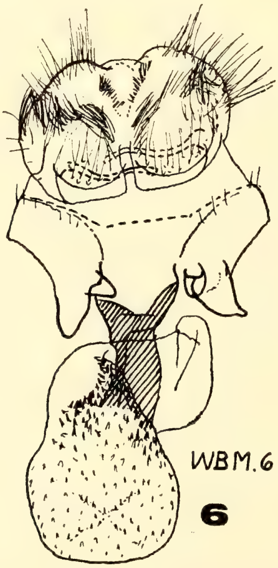
Though perhaps no more than a subspecies of *cuculliella*, described above, I introduce it provisionally as a distinct new species on account of the obvious difference of facies and its different country of origin, African instead of Asiatic, though not far away. Only males of *cucculliella* have been taken, and of this African form, a single female only.



Beihania hyatti sp. nov.

Fore-wing, very similar to *cuculliella*, but lacking costal black marks, perhaps due to rubbing ; hind-wing, however, with broad, dense, blackish marginal band covering half the wing. Fringe, white.

Span :—24 mm.



Beihania hyatti sp. nov. female genitalia

Female genitalia (Fig. 6): anterior apophyses with a second pair of lobe-like pockets, absent from *anartoides* ; bursa, with numerous spicules, sparser towards the fundus than distally ; appendix, not spinose nor spiculated.

Holotype, ♀, (Prep. WBM. 6) SOMALILAND, 2200 ft., iv. 1929, leg. M. Portal Hyatt, in British Museum.

Growth and Propagation of Common Carp (*Cyprinus carpio* L.) in India—V

Observations on the size of eggs, hatchlings and fry of parents of various size[1]

BY

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AND

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INTRODUCTION

A stock of common carp, originally imported from Prussia, was introduced into India in 1939 (Chacko 1945). Left to breed naturally in the Nilgiri waters, this stock comprises a mixture of mirror carp (*C. carpio* var. *specularis*), scale carp (*C. carpio* var. *communis*) and leather carp (*C. carpio* var. *nudus*)—the three commonly recognised varieties of this cosmopolitan species which has the distinction of being the most widely cultivated fish in the world. Though subsequently introduced into other parts of the country this stock has been mostly confined to the relatively cold, upland waters where all the varieties have been freely breeding. In the warmer waters of the Indian plains it was not found to breed freely and its utility as a pond fish for the plains, therefore, remained relatively unexplored.

A consignment of common carp that breeds freely in the South-East Asian countries was brought to Cuttack in 1957 with a view to try its utility for cultivation in the Indian plains (Alikunhi *et al.*—unpublished). These are pure scalers (*C. carpio* var. *communis*) and have been breeding prolifically at Cuttack since March, 1958.

Repeated observations at Cuttack have shown that under normal pond conditions this fish matures when it is 18-20 cm. long and weighs about 0·12 kg. Fishes ranging up to 6·0 kg. and over are now used in experimental as well as commercial breeding at Cuttack. During this work differences in the size of eggs, hatchlings and fry of parents of different size were frequently observed and it was felt necessary to examine this carefully and ascertain whether such differences, if they really exist, are of any cultural significance. During the period 1960-63 fifty-two pairs of common carp of selected size were specially bred to study the eggs, hatchlings and fry and these observations are recorded in the present paper.

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[1] Paper presented at the 49th Session of the Indian Science Congress at Cuttack, January 1962 and published with the permission of the Director, C.I.F.R.I., Barrackpore.

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MATERIAL AND METHODS

The length and weight of the female and male breeders were recorded when fishes were kept in *hapas*[1] for breeding. For purposes of this study single females were mated with single males of comparable size so that parentage of the entire batch of eggs was definite. Laid eggs sticking on to weeds kept in the *hapas* were collected and random samples measured under the microscope. Samples on weeds were kept in enamel trays, in tap water and in pond water in the laboratory. When the eggs started hatching 50 to 100 hatchlings were collected, generally within 4 to 6 hours of hatching and their total length was measured. At the same time 50 to 100 hatchlings from the hatching *hapa* fixed in the pond were also taken and measured for purposes of comparison.

To find out whether fry from parents of markedly different size show differences in growth when reared under identical conditions, samples of fry were reared in laboratory aquaria for periods of 20 days. At the end of the period surviving fry in different aquaria were fixed, measured and weighed.

OBSERVATIONS AND RESULTS

Eggs : When a representative sample of fertilised eggs from a batch is examined we find them falling within a particular range of size. Eggs from large females also appear larger than those from smaller females. The range of size and frequency of each size of eggs from 52 selected specimens arranged in 5 size groups at 10 cm. intervals are given in Table I.

Diameter of the eggs, excluding the vitelline space and egg membrane was measured under the microscope. The samples were arbitrarily divided into 4 groups of almost equal range and analysed. It is seen from the table that in the smaller fish the proportion of the smaller eggs is predominant and that as the size of the female increases the diameter of the predominant group of eggs also increases. The first group of

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[1] Rectangular cloth tanks of various size, supported by bamboo poles at corners.

TABLE I

RANGE AND FREQUENCY OF SIZE OF LAID EGGS OF *Cyprinus carpio* IN RELATION TO THE SIZE OF THE FEMALE

Group	No. Examined	*Female* Length (cm.)		*Female* Weight (kg.)		Diameter of laid eggs (mm.)		% of eggs in dia. group (mm.)			
		Range	Av.	Range	Av.	Range	Av.	I up to 1·18	II 1·18-1·36	III 1·36-1·54	IV 1·54+
1.	9	15·0-25·0	20·34	0·119-0·398	0·200	0·90-1·51	1·21	50	46	4	—
2.	7	26·0-35·0	31·12	0·334-0·767	0·631	0·96-1·51	1·23	27	57	16	—
3.	12	36·0-45·0	40·65	1·122-1·925	1·389	1·01-1·65	1·32	6	63	30	1
4.	15	46·0-55·0	50·75	2·200-4·540	3·016	1·01-1·56	1·34	4	46	49	1
5.	9	56·0-65·0	59·21	3·973-6·129	4·769	1·10-1·65	1·41	2	23	67	8

eggs up to 1·18 mm. in diameter progressively becomes scarce (50% to 2%) as the weight of the parent fish increases to 4-6 kg. Likewise, the proportion of the larger eggs (group II & III) steadily increases with the size of the parent. In the 15 to 35 cm. length range of females the largest diameter of eggs encountered was only 1·51 mm. While the average length of the female breeder increases from 20 to 59 cm., the average diameter of the laid eggs increases from 1·21 mm. to 1·41 mm. This actual increase by 0·20 mm. represents 16·5% increase in diameter. In terms of volume of the egg and consequent quantity of stored up material in the egg the increase averages 58%.

Soon after fertilization the egg swells up by water absorption and a narrow vitelline space appears between the egg and its surrounding vitelline membrane. The overall diameter of the fully swollen egg shows some variations, depending perhaps on the conditions of the medium, but even here progressive increase in size is evident as the size of the parent increases (Table II).

TABLE II

OVERALL DIAMETER OF FULLY SWOLLEN EGGS OF *C. carpio* IN RELATION TO SIZE OF THE FEMALE

Group No.	Female		*Av. Diameter (mm.) of egg*	
	Average length (cm.)	Average weight (kg.)	Excl. vit. space	Including vit. space
1.	20·34	0·200	1·21	1·51
2.	31·12	0·631	1·23	1·65
3.	40·65	1·389	1·32	1·64
4.	50·75	3·016	1·34	1·70
5.	59·21	4·769	1·41	1·73

The average increase in diameter of the fully swollen egg is 14·5% from the first to the fifth group and the corresponding increase in volume is almost 46%; both very much similar to the respective increase in the case of the egg excluding the vitelline space.

Hatchlings : Measurements of hatchlings from parents of different size also show, as in the case of eggs, a progressive increase in length (Table III).

Hatchlings obtained by keeping developing eggs in pond water in trays in the laboratory were used for the above measurements. As stated earlier the samples were fixed 4-6 hours after hatching com-

TABLE III

RANGE AND FREQUENCY OF SIZES OF HATCHLINGS OF *C. carpio* IN RELATION TO THE SIZE OF THE FEMALE BREEDERS

Size group of female breeder[1]	Length in mm. of hatchlings		% of hatchlings in size groups (mm.)			
	Range	*Average*	I up to 4·72	II 4·72 to 5·44	III 5·44 to 6·16	IV above 6·16
1.	4·40-5·68	4·99	11	82	7	. .
2.	4·03-5·31	4·76	36	64	. .	. .
3.	3·76-5·68	4·83	30	69	1	. .
4.	3·66-5·95	4·77	45	40	15	. .
5.	3·66-5·86	5·00	26	51	23	. .

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[1] Length and weight of breeders same as in groups 1 to 5 of Table I.

menced. When the hatching is prolonged the samples are likely to include a few newly hatched larvae also, irrespective of the size of the parent. In spite of this the gradually increasing trend is clear and the percentage of larger hatchlings (group III) increases as the size of the female parent increases.

Hatchlings just emerging from the eggs were collected and measured in two batches taken from parents of different sizes and were analysed (Table IV).

The Table shows that the hatchlings of the larger fish are nearly $\frac{1}{8}$th longer than those of the smaller fish. In the same batch of hatchlings the largest one is generally 20 to 24% longer than the smallest one. Further, smaller hatchlings predominate in the case of the smaller fish while, in the larger fish the smaller hatchlings are relatively very few, the larger ones predominating.

Size of Hatchlings in Different Media : It was noted that when eggs from the same batch are hatched under different conditions and in different media the length of the hatchlings varied markedly. When hatched in cloth *hapas* fixed in the pond and in pond water and in tap water in trays in the laboratory, the length of hatchlings varies (Table V).

While the pond water is alkaline in pH and rich in nutrients, tap water is acidic or neutral in pH and poor in nutrients. Water temperature in the pond was also consistently higher than that in trays in the laboratory. Pond water and tap water in trays in the laboratory had identical temperature though dissolved nutrients, gases and pH were different. It is possible that under the above conditions of pond water there is better utilisation of yolk.

Irrespective of the environment in which the eggs were hatched the average length of the hatchlings increases with the increase in size of the female parent. This trend is evident even at the end of the second day after hatching when the stored-up yolk has been fully utilised by the hatchling. The hatchlings from the pond are about 14% longer than hatchlings in pond water in trays in the laboratory. When measurements of representative samples of hatchlings from different broods of eggs are arranged in groups the relative abundance of these groups indicate the same trend as in the case of eggs (Table VI).

Under laboratory conditions as well as in the pond the length of hatchlings increases with the increasing size of the parent. The smaller hatchlings in groups I and II steadily become scarce in broods from parents of groups 4 and 5. Under laboratory conditions, the average length of hatchlings being shorter the above trend is not so obviously brought out as under pond conditions.

Survival and Growth of Hatchlings : As hatchlings from eggs of large breeders were generally larger than those from smaller breeders, attempts

TABLE IV

RANGE AND FREQUENCY OF SIZES OF EGGS AND HATCHLINGS FROM TWO FEMALE BREEDERS OF *C. carpio* OF DIFFERENT SIZE

Size of Female		Diameter of eggs Excl. vit. space (mm.)		Frequency (%) of sizes (mm.)			Hatchlings in pond water in the lab. length (mm.)		Frequency % of sizes (mm.)		
Length (cm.)	*Weight* (kg.)	*Range*	*Average*	I up to 1·18	II 1·18-1·36	III 1·36-1·54	*Range*	*Average*	I up to 4·72	II 4·72-5·44	III 5·44-6·16
37·6	1·12	1·15-1·42	1·27	8	84	8	4·48-5·31	4·93	76	24	..
60·5	4·17	1·28-1·56	1·42	..	16	76[1]	4·70-5·95	5·41	6	58	36

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[1] 8% of the eggs larger than size III.

TABLE V

SIZE RANGE OF HATCHLINGS OF *C. carpio* WHEN EGGS ARE HATCHED IN DIFFERENT ENVIRONMENTS

♀ Parent's size group	*Range and Average length of hatchlings (mm.) in the*			*Range and Average length of hatchlings (mm.) after yolk absorption in the*		
	Pond	*Laboratory*		*Pond*	*Laboratory*	
		in pond water	in tap water		in pond water	in tap water
1.	4·03-6·41 (5·14)	4·40-5·68 (4·99)	3·30-6·05 (4·38)	4·85-6·87 (6·26)	3·76-6·76 (5·76)	3·94-6·69 (5·67)
2.	4·58-6·14 (5·59)	4·03-5·31 (4·76)	3·00-5·22 (4·55)	5·59-6·96 (6·48)	3·66-7·14 (6·17)	4·03-6·50 (5·54)
3.	4·03-6·05 (5·11)	3·76-5·68 (4·83)	3·39-5·50 (4·57)	5·50-7·42 (6·51)	4·40-6·78 (5·76)	4·55-6·60 (5·52)
4.	3·94-6·69 (5·28)	3·66-5·95 (4·77)	3·21-6·05 (4·75)	5·68-7·33 (6·56)	4·03-7·23 (5·96)	4·58-5·86 (5·40)
5.	3·85-6·60 (5·70)	3·66-5·86 (5·00)	4·12-5·77 (5·06)	5·56-7·67 (6·66)	4·95-6·87 (5·96)	..

TABLE VI

FREQUENCY OF DIFFERENT SIZE GROUPS OF HATCHLINGS IN RELATION TO THE SIZE OF PARENTS

Female Parent Group No.	Hatchlings in *hapa* in the pond				Hatchlings in trays in the laboratory							
	Percentage of size groups (mm.)				Percentage of size groups (mm.)							
					In pond Water				*In tap Water*			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
1.	33	27	37	3	11	82	7	..	86	10	4	..
2.	..	27	73	..	36	64	..	..	62	38	..	..
3.	25	37	38	..	30	69	1	..	66	34	..	..
4.	23	32	40	5	45	40	15	..	51	43	6	..
5.	11	7	73	9	26	51	23	..	14	66	20	..

Note : I=up to 4·72 mm. ; II=4·72 to 5·44 mm. ; III=5·44 to 6·16 mm. ; IV=Over 6·16 mm.

were made to determine whether this initial advantage in length is of any significance in their early growth and survival. Fishes of widely different weights were artificially spawned under identical conditions and the eggs were also hatched under identical conditions. Ten litre capacity glass aquaria with equal quantity of filtered pond water were set up and at 100 fry per aquarium three random lots from each brood of fry were kept for rearing. The fry in various aquaria were fed daily with identical quantities of fresh zoo-plankton. Survival and growth of fry at the end of 20 days of rearing are given in Table VII.

TABLE VII

C. carpio, SURVIVAL AND GROWTH OF FRY FROM PARENTS OF DIFFERENT SIZE

No.	Size of ♀ Parent		Av. size of fry at stocking		Av. size attained in 20 days		Survival %
	Length (cm.)	Weight (kg)	Length (mm.)	Weight (mg.)	Length (mm.)	Weight (mg.)	
1.	21·2	0·243	5·92	0·96	14·25	25·1	94
2.	29·6	0·643	7·08	1·70	15·95	40·8	87
3.	50·4	3·165	7·45	2·64	16·51	48·3	86
4.	57·7	3·748	6·53	1·70	14·89	24·3	99

Specimens 1-4 and 2-3, with similar size males formed the sets of breeders from which fry were obtained for simultaneous rearing. Though several more such lots have to be reared in the laboratory and also in the field before reliable conclusions can be drawn, the preliminary results indicate that under comparable conditions fry of the larger breeders grow slightly faster than those of the smaller fish. At commencement of rearing the fry of the two larger fish were about 7·5% larger than the fry of the smaller fish. After 20 days of rearing they remained longer by only 4%. By weight, the fry of the larger fish were about 55% heavier at commencement of rearing, than those of the smaller fish. At the end of the rearing period, this difference was appreciably reduced and they were only about 10% heavier than the fry of the smaller fish. However, when the actual increase in length and weight is compared with the initial length and weight of fry in each case, we find, in this particular series, the fry of the smaller parents growing better, though with a slightly lower survival. Prevezentsev (1964) studying the size, weight and chemical composition of eggs and larvae of 4, 7 and 10 year old spawners found best indices for the offspring of average size spawners and poorest for those of first time spawners.

DISCUSSION

According to Martyshev (Quoted by Nikolsky, 1963) in the carp, *C. carpio* L., the largest broods are those produced by fishes of age 8+ ; the young and older individuals produce less viable young. Depending on the age of the fish the diameter of eggs and length of hatchlings also vary as follows (Nikolsky, 1963, p. 173).

	Age of carps in years			17+
	3 +	4 +	8 +	
Average diameter of eggs (mm.)	1·26	1·39	1·71	1·64
Average length of hatchlings (mm.)	4·80	5·05	6·41	6·18

Observations recorded in the present paper show a similar correlation of the length and weight of the fish with the size of eggs and hatchlings as follows :

Average size of breeder		Av. diameter of eggs (mm.)	Average length of hatchling (mm.)
Length (cm.)	Weight (kg.)		
20·0	0·20	1·21	5·14
31·0	0·63	1·23	5·59
41·0	1·39	1·32	5·11
51·0	3·02	1·34	5·28
59·0	3·75	1·41	5·70

Careful analysis of the batches of eggs laid by breeders of different size has shown : (*a*) an appreciable range in the size of eggs ; (*b*) a predominance of a particular size correlated with the size of the breeder and, (*c*) presence often of a low percentage of relatively large eggs. This applies in the case of hatchlings as well.

The occurrence of a limited number of fast growing fry in a batch hatched from a parent has been repeatedly observed in common carp. In the case of Indian carps, *Catla*, *Rohu* and *Mrigal* also such fast growing specimens appear when batches of fry from a brood are reared in ponds. In Japan such fast growing carps are called '*Tobi-Koi*' or '*Shoot carps*' (Matsui 1949, Nakamura & Kasahara 1955). Matsui (1949, 1950) is of the view that these '*shoot carps*' can be distinguished from normal specimens of *C. carpio* by morphological characteristics which are of genetic significance and which could, therefore, be fixed by selective breeding to yield a faster growing strain. Nakamura &

Kasahara (1955, 1956, & 1957) have tried to show that competition for food between individual fry within a batch is an important causative factor for the occurrence of '*shoot carps*' and as such these fast-growing specimens may not be of genetic significance.

If we concede that the fry of the larger parent (generally of a larger average size) grow faster than the fry of the smaller parent (generally of a lower average size) (Nikolsky, 1963) it may be possible to infer that the relatively small percentage of larger hatchlings in a batch would grow faster than the rest in the batch. If this could explain the occurrence of '*shoot carps*' then it might possibly be of some genetic significance. Particle size, paucity of food and competition result in extreme skewness in the batches of fry reared in ponds but it also shows that a few of the fry in the batch have greater capacity to ingest and assimilate food than others and it is yet to be ascertained if this capacity could be fixed.

The observation that eggs of the same batch hatched in different media under other identical conditions result in hatchlings of different size would indicate that in ponds with widely differing water conditions, the hatchlings of carp of a particular size could be of different sizes. Selective breeding and extensive progency testing (Wohlfarth *et al.*, 1961) have to be carried out in order to arrive at tangible results out of trends indicated in this paper.

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A Population Survey of the Bonnet Monkey (*Macaca radiata* Geoffroy) in Bangalore, South India

BY

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(*With a map*)

This paper presents data on the population of Bonnet Monkeys (*Macaca radiata* Geoffroy) in different parts of Bangalore city. In all, 20 sectors or postal zones were surveyed from August 1964 to January 1965. The zones other than those enumerated in the table at page 253 were entirely devoid of monkey population. There is no other species of monkey in Bangalore, with one exception in the Cubbon Park troop which has accepted a Rhesus female, probably an escape from captivity.

The objectives of the population survey were to gather data on the abundance and the distribution of bonnet monkeys, and on group-size and composition, to ascertain the ecological factors responsible for the distribution and troop size, and to study food and habitat preferences.

DESCRIPTION OF THE AREA

The city of Bangalore (the capital of Mysore State in south India) lies between 12°55′ and 13°03′N. and 77°32′ and 77°44′E. and has an area of nine square miles. The elevation of the highest Bangalore table-land is approximately 3000 ft. above sea-level.

The dry crops are ragi (*Eleusine corocana*), cow gram (*Dolichos lablab*), jola (*Sorghum vulgare*), horse gram (*Dolichos biflorus*), etc., and a variety of other items of less intensive cultivation. A noteworthy feature is the occurrence of flowers throughout the year owing to the salubrious climate.

The climate of Bangalore is dry in January, February, March, and December, with little or no rain, i.e. 0·1 to 0·5 mm. In June and

November there is slight rain, in May, July, August, and October moderate rain, about 125 mm. The highest rainfall recorded is in the month of September going up to 170 mm.

The average mean temperature and diurnal range at Bangalore are in January 74 and 16, May 80 and 22, July 74 and 16, November 71 and 17 Fahrenheit. (Imperial Gazetteer of India, Mysore and Coorg; 1927).

The minimum temperature as recorded in the months of November, December and January is approximately 13°C. to 15°C., and occasionally goes down to 10°C. The temperature is highest in March, April and May i.e. 30° to 34°C. During the rest of the period the average temperature is 24°C. The population of Bangalore is about fourteen lakhs.

METHODS

Bangalore with its availability of water, food, and shelter was convenient for survey of the monkey population of an urban area. The roadside shopkeepers on many occasions could give us information regarding the presence of monkeys in their vicinity, as their exposed wares attract the animals.

The search of temple localities gave most fruitful results, in some areas more than one troop being encountered. Duplication of counting was avoided by identifying individual troop members. Some members of each troop were discriminated by such characteristics as brow wounds, scars, freckles, tears in the ears, and so on. After sometime, we could easily distinguish individual monkeys by their facial characteristics.

For group composition all members of a troop, males and females, were classified according to age groups into adults (above 5 years), juveniles (1-3 years), and infants (below 1 year).

RESULTS

In the five months, during which the population was surveyed, a total of 14 troops was seen in different localities (Table and Map). In the Table the different localities are grouped in ecological sectors.

NATURE OF HABITAT AND FOOD

Garden Sector

Lal Bagh, the State botanical and horticultural garden, is a very old garden and one of the best of its kind in the East. It has various types of economic plants, fruits, arboretum, herbs, and a variety of flora under cultivation, such as palms, conifers, giant bamboos, orchids, and an assemblage of other plants including coffee, mulberry, baniah cotton, American upland cotton, medicinal plants like cinchona, chalmogra, digitalis, aromatic plants like, pachouli, citronella, linaloe, and a variety of fruit-bearing plants. Cubbon Park also has many plants of botanical interest. The sector also includes boulevards and green lawns.

TABLE

GROUP SIZE AND COMPOSITION OF TROOPS

Locality		Sl. No. of Troops	Adult ♂	Adult ♀	Juveniles	Infants	Total
Garden Sector :							
(Total Population 65).							
Lal Bagh (Tank)	..	1	3	11	5	3	22
Lal Bagh (Gate)	..	2	3	6	5	6	20
Cubbon Park	..	3	4	5	7	7	23
Temple Sector :							
(Total Population 84).							
Malleswaram	..	4	2	5	5	2	14
Gandhi Bazar	..	5	8	7	5	7	27
Nagartharpet	..	6	20	12	4	7	43
Market Sector :							
(Total Population 110)							
Yeshwanthapur		7	3	7	6	1	17
Ulsoor ..	..	8	5	6	5	4	20
Subedar Chatram Rd.		9	7	12	5	4	28
Tharangpet	..	10	10	16	3	2	31
Chamarajpet	..	11	5	5	4	..	14
Extension Sector :							
(Total Population 37)							
Mekhri Circle	..	12	5	4	1	1	11
Wilson Garden	..	13	3	4	1	2	10
Fraser Town	..	14	6	7	1	2	16
Total	..	14	84	107	57	48	296

The monkeys feed on practically all the plants, especially bamboo-shoots, mango leaves, and flowers, mulberry, *Ficus*, grass blades, discarded oats, grasshoppers, flies, and even the pupae found on the under-surface of leaves.

Temple Sector

The habitat around the temples is not as rich in vegetation as the garden sector, but there is plenty of food and protection as temple environs are in the nature of a sanctuary. All temples have at least a few large trees that offer shelter. The food consists chiefly of left-overs of the offerings made by visitors in the form of rice, bananas, coconuts, and so on. Sometimes visitors feed them with buns, bread, and other edibles.

Market Sector

This habitat is heavily congested and devoid of vegetation ; instead, it has tall buildings, and all types of shops, hawkers, and pavement vendors. The food is mainly discarded fruits, vegetables, rice, and at times the monkeys do not hesitate to pilfer food from a passer-by, either stealthily or aggressively, the latter especially from women and children.

Extension Sector

The habitat consists of spaced shops and houses, with a few big trees that offer shelter. For food the monkeys chiefly depend upon left-overs, scraps found in garbage heaps, and leaves.

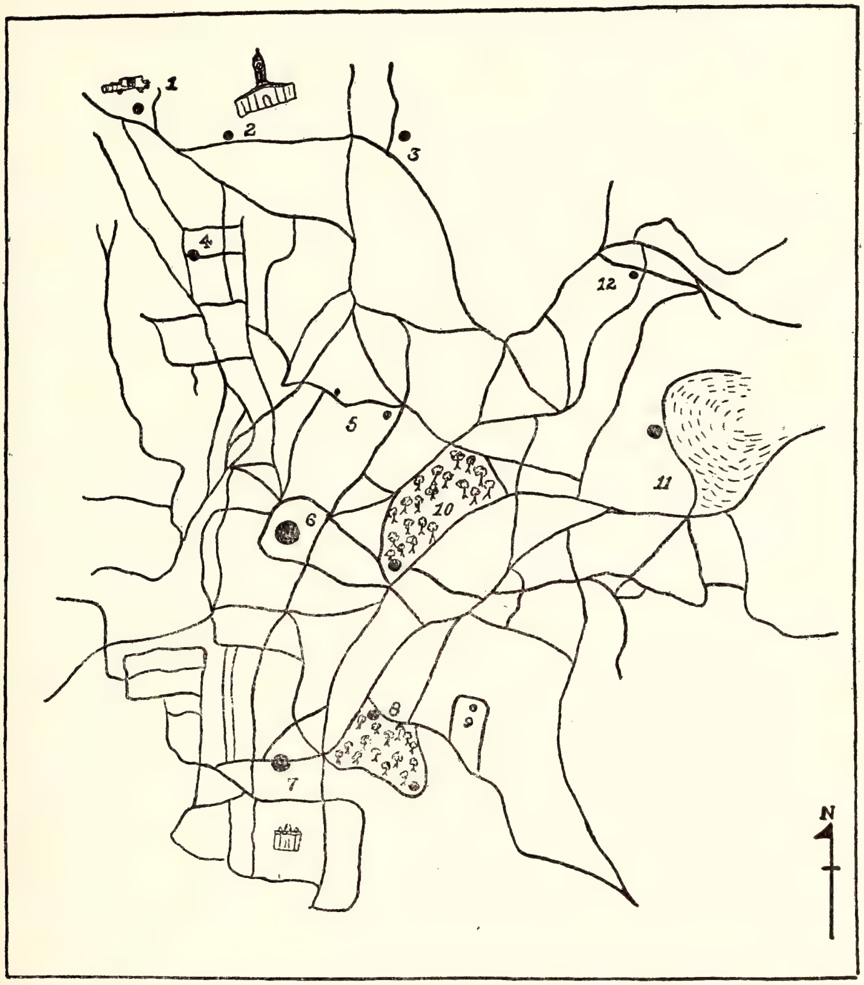
CONCLUSIONS

On a comparative assessment the average troop size of the garden sector is 21·6, the temple sector 28, the market sector 22, and the extension sector 12·3.

The market sector harbours more troops than other sectors, probably due to the habitat advantages and easy availability of food and shelter. Here even roof tops of tall buildings become sleeping quarters of the animals during night. The temple sector has the next largest concentration, probably due to the availability of food and shelter. Next comes the garden sector, where the monkeys have shelter and a variety of food, but are exposed to a certain amount of harassment. The extension zone, because of the scarcity of food and shelter, has the least number of monkeys.

The Bonnet population in Bangalore is not as dense as the Rhesus population seen in the villages of north India and does not have their relative troop size (Southwick, Beg, & Siddiqi 1961). Though, some of the troops may have as many as 47 to 50 members, the average troop size remains small (21·14).

The sex ratio in troops 3, 5, 8, 11, 12, 13 and 14 was approximately 1 : 1 in troops, 1, 2, 4, 7, 9 and 10, the number of females was more than that of males, and in troop 6 the number of males was more than the females. It seems that the differences in the sex ratio is related to the sex ratio of the new born. No exclusively male group has been seen, in contrast to that of langur (Phyllis Jay 1961), and no solitary monkey was seen either.



Map of Bangalore showing the location of the different troops. (Dots)

1. Yeshwanthapur.
2. Indian Institute of Science.
3. Mekhri Circle.
4. Malleshwaram.
5. Gandhi Nagar.
6. Tharagpet.
7. Gandhi Bazar.
8. Lal Bagh.
9. Wilson Garden.
10. Cubbon Park.
11. Ulsoor.
12. Fraser Town.

The ecological factors responsible for the distribution of Bonnet Macaques are chiefly, food, shelter, and safety.

The number of monkeys, in Bangalore, in our opinion is not so large as to cause any serious damage, though their nuisance value and depradations in fruit and vegetable gardens is not inconsiderable. Attempts are being made to collect some statistics regarding the extent of damage done.

ACKNOWLEDGEMENTS

We wish to thank the Council of Scientific and Industrial Research, Rafi Marg, New Delhi, for the grant of fellowship to one of us (H.R.), and Professor B. A. Gulam Ahmad, Head of the Department of Zoology, Central College, Bangalore, for his kind encouragement throughout this study.

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Insects attracted to mercury vapour lamp in the Surat Dangs, Gujarat State

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AND

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In 1964 [*J. Bombay nat. Hist. Soc.* **61**(2) : 281-294] we published a list of moths that were attracted to light in the Dangs. The observations were continuous for 3-4 years (1961-64) and insects of all orders that came to light were caught for identification. The general ecological conditions were more or less similar for all the years and therefore the weather data are not repeated as they were given in the last paper. A large number of moth species which were not found in the previous season were attracted in the subsequent years and are included in the list. Those mentioned in the last article have not been repeated. About 17 species of butterfly came to the light and their names have been published by one of us (EMS) in the *Journal of the Lepidopterists' Society, U.S.A.* Vol. **18**(3) : 159-163 (1964). These are mentioned in the present paper for information. Additionally there are more than 200 species belonging to different orders which are listed below. The total number of species attracted to light works up to considerably more than 400. Out of these, the number of moth species is 222 (180 reported in the last paper and 42 in the present list) making up nearly 50% of the insect species caught. Coleoptera totalled to 72, Hemiptera 54 and Orthoptera 43 species including Mantidae (now considered a separate order, Order Dictyoptera), not an inconsiderable number, when one takes into consideration the general impression that it is only the moths which are attracted to light.

This subject is of general, popular, interest and therefore the technicalities of systematics have not been strictly observed in its presentation. Instead, the orders, families, species etc. have been arranged alphabetically so that a layman could easily refer to them when required.

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In recent years this method has become rather common. Secondly, the localities from which these species were previously collected in India have been shown. This information is taken generally from the FAUNA OF BRITISH INDIA volumes. Localities of those species which are not found in the FAUNA have been taken from the registers of insects in the collection of the Bombay Natural History Society. Quite possibly extension in the range of distribution of many of these species have been already recorded. But as papers in which these have been published are not easily available, we have restricted ourselves to these two sources only. Our main object is to show that these insect species are found in the Dangs area and are attracted to light. Other information is only incidental. Thirdly, the number of specimens of each species collected is given to give a rough idea of their abundance during the period, but this may not give a correct view of the relative abundance of different families as a large number of smaller insects must have escaped the collector's attention.

Most of the insects were identified by one of the authors (NTN). Those which could not be identified by us or about which there were doubts had to be sent out for the purpose. Local authorities as well as some foreign institutions like the Academy of Natural Sciences of Philadelphia were approached but most of them could not undertake to do this work either due to want of authoritative identifier or for want of time. Considerable time, however, was lost in these attempts and the publication of this part of the paper was consequently delayed. The Forest Research Institute, Dehra Dun, however, was of great help to us in this respect. We are indebted to them for the identification of a large number of our unidentified specimens, specially of the order Orthoptera (Acrididae and Gryllidae). Indian Agricultural Research Institute, New Delhi, also identified a few specimens for which we are thankful. A number of specimens mostly Trichoptera, Plecoptera and a few Hymenoptera and Orthoptera (Tettigoniidae) could not be identified and had to be omitted from this paper. Inclusion of these species would have increased the list by at least another 25-35 species.

INSECTS COLLECTED AT LIGHT AT AHWA IN THE DANGS

Serial No.	Family and Species	No. collected	Distribution previously recorded
	ORDER COLEOPTERA		
	Fam. Anthicidae		
1	*Anthicus hirsutus* Fr.	3	N. Kanara
	Fam. Bostrychidae		
2	*Sinoxylon pugnax* Les.	1	Punjab
	Fam. Buprestidae		
3	*Demochroa mutabilis* Ol.	1	Karwar, Bombay, Khandesh
4	*Sternocera laevigata* Ol.	1	Central India
5	*Sphenoptera gossypii* Ker.	1	All over India
	Fam. Carabidae		
6	*Brachynus reyi* And.	2	Igatpuri, N. Kanara, Bombay, Madras
7	*Carabid* sp.	2	
8	*Chlaenius rayotus* Bat.	1	Throughout India
9	*Clivina indica* Putz. (=*C. memnonia* Dej.)	5	India
10	*Distrigus* sp.	2	..
11	*Gnathaphanus punctilabris* Mac.	9	Throughout India
12	*Harpaliscus* sp.	3	..
13	*Lesticus desgodinsi* Teh.	1	Sikkim, Gopaldhara, Pashok
14	*Macrocheilus bensoni* Hope	4	India
15	*Omphra pilosa* Kl.	8	All over India
16	*Ophonus indicus* Bat.	10	Himalayan tract, Kashmir to Bhutan
17	*Orthogonius opacus* Sch. & Go.	1	Garo Hills, Sikkim, Andamans, Maymyo (Burma)
18	*Oxylobus dispar* Andr.	2	Kanara, Belgaum, Talewadi, Travancore etc.
19	*Pheropsophus occipitalis* Mac.	6	Throughout India
	Fam. Cerambycidae		
20	*Apriona trilineata* Fab.	1	Mussoorie, Kathmandu, N. Kanara
21	*Arlara cylindracea* White	1	..
22	*Batocera rubra* L.	1	Widely distributed in the oriental region
23	*Celosterna scabrator* Fab.	4	Widely distributed in India
24	*Coptops aedificator* Fab.	1	Bengal, Orissa, U.P., M.P., etc.
25	*Glenea vexator* Pasc.	1	Belgaum, Bombay etc.
26	*Neocerambyx paris* Wied.	1	Mysore State, Bombay, Assam
27	*Plocaederus ferrugineus* L.	1	Trivandrum, N. Kanara, Khandesh
28	*Prionomma atratum* Gme.	4	S. India
29	*Sthenias grisator* Pasc.	1	Belgaum, N. Kanara, Bombay, Palanpur
30	*Xylotrechus smei* L. & G.	3	N. India, Deccan
31	*Xystrocera globosa* Ol.	1	Darjeeling, Bombay, Madras, Mysore

Serial No.	Family and Species	No. collected	Distribution previously recorded
	Fam. Chrysomelidae		
32	*Chrysomelid* sp.	1	
	Fam. Cicindelidae		
33	*Cicindela cancellata* Dej.	1	All over India
	Fam. Coccinellidae		
34	*Coccinellid* sp.	4	..
	Fam. Dytiscidae		
35	*Cybister confusus* Shp.	1	Bombay, Karwar
36	*Hydraticus luczonicus* Aub.	1	Khandesh
	Fam. Elateridae		
37	*Agrypnus* sp.	1	..
38	*Alaus sordidus* Westw.	3	Kandy (Ceylon)
	Fam. Gyrinidae		
39	*Dineutus indicus* Aub.	1	Common all over India
	Fam. Hydrophilidae		
40	*Hydrophilus spinicollis* Esch.	8	Tharawaddy (Burma), N. Kanara, Kasara, Pusa, Brahmaputra
41	*Sternolophus brachyacanthus* Reg.	10	Bihar, Khandesh
42	*Sternolophus unicolor* Cast.	2	Khandesh
43	*Slethoxus* sp.	1	..
	Fam. Lucanidae		
44	*Cladognathus giraffa* Ol.	1	Assam, U.P., Bengal, Andamans, Cuddapah (A.P.)
	Fam. Meloidae		
45	*Cantharis ardosia* Fairm.	5	Bombay, Kanara
46	*C. rouxi* Cast.	5	Kanara, Karachi, Nasik, Mt. Abu
47	*Epicauta cognata* Haag.	3	N. Kanara
48	*E. hirtipes* Wat.	1	Nepal
49	*Sybaris procrastus* Koll. & Red.	6	Bombay, Bangalore
	Fam. Scarabidae		
50	*Anomala bengalensis* Bl.	1	Common all over India
51	*Anomalachela bicolor* Brsk.	1	Nilgiris
52	*Aphodius crenatus* Hey.	3	Karachi
53	*Apogonia ferruginea* F.	7	Bombay, Andamans
54	*Catharsius molossus* L.	5	All over India
55	*C. pithecius* F.	4	do.
56	*Chiloloba acuta* Wied.	2	Sikkim, Dehra Dun, Belgaum, Mhow, Malabar etc.
57	*Copris indicus* Gill.	2	Madras, Mysore, Travancore
58	*Helicopris bucephalus* Fab.	5	All over India

Serial No.	Family and Species	No. collected	Distribution previously recorded
59	*Holotrichia pulvinosa* Shp.	6	Bombay
60	*Onitis virens* Laus.	9	All over India
61	*Onthophagus ramosus* (Wied).	3	do.
62	*Oryctes* sp.	1	
63	*Rhinyptia indica* Burm.	1	Belgaum, Bombay, Nagpur, Madras
64	*Scarabid* sp.	1	..
65	*Serica* sp.	6	..
66	*Xylotrupes gideon* L.	2	All over India
	Fam. Staphylinidae		
67	*Philonthus* sp.	1	
	Fam. Tenebrionidae		
68	*Camaria angulicollis* Fair.	1	Nilgiris, Coorg, Kanara
69	*Gonocephalum depressum* F.	2	Bombay, Belgaum, Berars, Madurai
70	*G. oblongum* F.	5	Berars
71	*Sleron reitheri* Geb.	10	Bombay, Berars
72	*Strongylium* sp.	3	..
	ORDER DERMAPTERA		
	Fam. Labiduridae		
73	*Forcipula quadrispinosa* Doh.	12	Sikkim, Bhutan, Bengal, Madras, Travancore
74	*F. trispinosa* Doh.	4	Nepal, Bengal, U.P.
75	*Labidura bengalensis* Doh.	4	Bengal, Madras
76	*L. lividipes* Duf.	2	Bengal, Pusa, Madras, Bombay
77	*L. riparia* Pall.	8	Cosmopolitan
78	*Psalis dohrni* Kir.	2	Travancore, Northern side of Western Ghats
	ORDER HEMIPTERA		
	I. *Heteroptera*		
	Fam. Belostomatidae		
79	*Sphaerodema rusticum* Fab.	9	Bombay. Widespread
80	*Belostoma indicum* L.	1	do. do.
	Fam. Coreidae		
81	*Acanthecoris scabrator* Fab.	1	Sikkim, Assam, Khasi hills
82	*Cletus bipunctatus* Westw.	1	Bombay, Bengal, Bangalore
83	*Notobitus dorsalis* Westw.	3	Bengal, Bombay
84	*N. meleagris* Fab.	7	Nilgiris
85	*Serinetha rufomarginata* Fab.	2	Bombay, Calcutta
86	*Serinetha* sp.	3	
	Fam. Lygaeidae		
87	*Aphanus orientalis* Dist.	2	Bombay, Bengal, Bihar, Mysore
88	*Dieuchus uniguttatus* Thumb.	5	Assam, Bombay, Bangalore
89	*Lethaeus indicus* Dall.	2	N. Bengal
90	*Oxycarenus laetus* Kirb.	2	Cosmopolitan
91	*Petillia pelulicollis* Wlk.	1	Sikkim

Serial No.	Family and Species	No. collected	Distribution previously recorded
	Fam. Pentatomidae		
92	*Chrysocoris stockerus* L.	1	Bombay, Bangalore, Trivandrum
93	*Cydnus indicus* Westw.	1	Bombay. Widely distributed
94	*Cyclopelta siceifolia* Westw.	3	Cosmopolitan
95	*Dalpada affinis* Dall.	1	Sikkim, Tenasserim
96	*D. nigricollis* Westw.	6	Punjab, Srinagar, Nepal, Bengal, etc.
97	*Degonetus serratus* Dist.	1	Bombay
98	*Dolycoris indicus* Stal.	4	Bombay, Calcutta, Darjeeling, Bangalore, etc.
99	*Erthesima fullo* Thumb.	5	Bengal, Assam, Trivandrum, Andamans
100	*Eusarcocoris guttiger* Th.	2	Assam, Bengal, Bombay
101	*E. ventralis* Westw.	3	Bombay, Bengal, Bangalore
102	*Eusarcocoris* sp.	1	..
103	*Halyomorpha picus* Fab.	1	Cosmopolitan
104	*Halys dentatus* Fab.	1	do.
105	*Laprius varicornis* Stal.	1	do.
106	*Nezara viridula* L.	2	do.
107	*Plecosternum alces* Stal.	1	Bombay
108	*P. dama* Fab.	1	Assam, Pondicherry, Cochin, Trivandrum
109	*Podops* sp.	4	..
110	*Tetroda obtusa* Dalb.	1	N. India
	Fam. Pyrrhocoridae		
111	*Dysdercus cingulatus* Fab.	1	Cosmopolitan
112	*Ectalops* sp.	1	..
	Fam. Reduviidae		
113	*Acanthaspis* sp.	1	..
114	*A. trimaculata* Reut.	1	Bombay, N. India
115	*Conorhinus rubrofasciatus* de Geer	1	Cosmopolitan
116	*Endoclus* sp.	1	..
117	*Opisthoplatys majusculus* Dist.	2	..
118	*Scadra fuscicrus* Stal.	3	..
119	*Tribelocephala indica* Wlk.	3	Bengal, Bombay
	II. *Homoptera*		
	Fam. Fulgoridae		
120	*Dictyophora* sp. 1	1	..
121	*Dictyophora* sp. 2	3	..
122	*Dictyopharina viridissima* Mots.	7	Bombay, Nilgiris
123	*Pulastya acutipennis* Kirb.	1	..
124	*Pyrilla perpusilla* W.	4	Bengal, Pusa, S. India, Common
125	*Udugama splendens* G.	1	Bombay
	Fam. Jassidae		
126	*Athysanus indicus* D.	1	Bengal, Pusa
127	*Bythoscopus* sp.	2	..
128	*Hecalus* sp.	2	..

Serial No.	Family and Species	No. collected	Distribution previously recorded
129	*Idiocerus niveosparsus* Leth.	3	Cosmopolitan
130	*Ledra quadricarina* Wlk.	1	Bengal, S. India
131	*Nephotettix apicalis* Mot.	2	Bengal
132	*Peregrinus maidis* (Ash.)	1	..
133	*Tettigoniella spectra* Dist.	1	Cosmopolitan
	ORDER HYMENOPTERA		
	Fam. Apidae		
134	*Apis dorsata* Fab.	1	Cosmopolitan
	Fam. Ichneumonidae		
135	*Paniscus testaceus* Grav.	2	Belgaum, Nasik
136	*Xanthopimpla pedator* Fab. =*Pimpla lepcha* Cam.	1	Bombay
137	*Ichneumon* sp.	2	..
138	*Ophion* sp.	3	..
	Fam. Pompilidae		
139	*Salius bipartitus* (Lep.)	2	Gudhalli
	Fam. Vespidae		
140	*Icaria ferruginea* Fab.	1	Karachi, Krohi, Matheran, Nasik, etc.
	ORDER LEPIDOPTERA		
	I. *Heterocera* (Moths)[1]		
	Fam. Arctiidae		
141	*Aemene guttulosana* Wlk.		Bengal, Nilgiris
142	*Creatonotus interruptus* Gmel.	..	Throughout India
143	*Miltochrista* (*Asura*) sp.	..	..
144	*Utetheisa pulchella* L.	..	Throughout India
	Fam. Geometridae		
145	*Hyperythra lutea* Cr.	..	do.
146	*Macaria eleonora* Cr. (=*M. fasciata* Fab.)		do.
147	*Tephrina disputaria* Guen.	..	do.
148	*Thalassodes flavifuscata* Wlk.	..	Sikkim
	Fam. Hypsidae		
149	*Argina cribraria* Cl.	..	Throughout India
150	*Hypsa ficus* Fab.	..	do.
	Fam. Lasiocampidae		
151	*Trabala vishnu* Lef.	..	do.
	Fam. Limacodidae		
152	*Parasa lepida* Cr.	..	Throughout India

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[1] The exact number collected of each species is not available. They varied from 1 to 3 in most of the cases.

Serial No.	Family and Species	No. collected	Distribution previously recorded
	Fam. Lymantridae		
153	*Dasychira bhana* Mo.	..	Sikkim, Nilgiris
154	*Euproctis immaculata* Mo.	..	Sikkim, N. Kanara
155	*E. scintillans* Wlk.	..	Throughout India
156	*Lymantria mathura* Mo.	..	N.W. Himalayas, Sikkim
157	*Porthesia xanthorrhoea* Koll.	..	Throughout India
158	*Thiasidas postica* Wlk.	..	do.
	Fam. Noctuidae		
159	*Agrotis bicornica* Koll.	..	All over India
160	*Chariclea bivittata* Wlk.	..	Bombay Presidency
161	*C. flavia* Hmps.	..	Mhow, Bombay, Deccan, Madras, Wynaad, etc.
162	*C. lanceolata*	..	Simla, Mhow, Nilgiris
163	*Earias fabia* Stoll.	..	Throughout India
164	*Euplexia* sp.	..	
165	*Hermonassa consignata* Wlk.	..	Kashmir, Dharamshala, Sikkim
166	*Homaea clathrum* Guen.	..	N.W. India
	Fam. Notodontidae		
167	*Fentonia tenebrosa* Wlk.	..	N. Kanara
168	*Gargetta costigera* Wlk.	..	Mandi, N.W. Himalayas, Sikkim
169	*Pydna endophaea* Hmps.	..	N. Kanara
	Fam. Pyralidae (Pyralididae)		
170	*Caprinia conchylalis* Guen.	..	Sikkim, Assam, Bombay, Nilgiris
171	*Euclasta defamatalis* Wlk.	..	Throughout India
172	*Glyphodes bivitralis* Guen.	..	Sikkim, Assam, W. & S. India, Andamans
173	*G. indica* Saund.	..	Very widely distributed
174	*Maruca testulalis* Gej.	..	do.
175	*Nymphula fluctuosalis* Zell.	..	do.
176	*Sameodes cancellalis* Zell.	..	All over India
177	*Sylepta lunalis* Guen.		Throughout India, Andamans
178	*Zinckenia fascialis* Cr.	..	Widely distributed
179	*Zinckenia* sp.	..	..
	Fam. Sphingidae		
180	*Deilephila livornica* (Esp.) (= *Celerio lineata livornica* Roth. & Jord.).	..	Throughout India
181	*Rhyncholaba acteus* (Cram.).	..	Widely distributed
	Fam. Thyrididae		
182	*Striglina scitaria* Wlk.	..	Throughout India
	II. *Rhopalocera* (Butterflies)		
	Fam. Hesperiidae		
183	*Hasora chromus* (Cr.)	8	Throughout India
184	*Pelopidas conjuncta* Hew.	1	Peninsular India, Dehra Dun to Assam, Calcutta

Serial No.	Family and Species	No. collected	Distribution previously recorded
	Fam. Lycaenidae		
185	*Zizeeria lysimon* Hubn.	1	India
	Fam. Nymphalidae		
186	*Ergolis merione merione* Cr.	1	India except the arid N. and N. W. regions
187	*Euthalia garuda* (Mo.)	2	India
188	*Precis hierta hierta* (Fab.)	1	do.
189	*Vanessa cardui* (L.)	1	All over India
	Fam. Pieridae		
190	*Catopsilia crocale* (Cr.)	1	India
191	*Eurema brigitta* (Cr.)	2	do.
192	*E. hecabe* (L.)	large number	do.
193	*E. laeta* Boisd.	2	do.
194	*Huphina* (*Cepora*) *nerissa* (Fab.)	1	do.
	Fam. Satyridae		
195	*Lethe rohria nilgiriensis* Guen.	1	S. India to Pachmarhi, Kashmir to Assam
196	*Melanitis leda* (Dr.)	large number	All over India
197	*Mycalesis perseus* (Fab.)	1	S. India to Bengal, Konkan, Lucknow, Kangra to Assam
198	*M. mineus* (L.)	3	Peninsular India. Madhya Pradesh, Bengal, Kulu to Assam
199	*Ypthima baldus* Fab.	1	All over India
	ORDER NEUROPTERA		
	Fam. Hemerobiidae		
200	*Myrmelion* sp.	1	
201	*Palperus pardus* Rbr.	4	Common
202	*Stanares probus* Wlk.	1	do.
	ORDER ODONATA		
	Fam. Agriidae		
203	*Vestalis smaragdina* Sel.	2	Assam
	Fam. Libellulidae		
204	*Brachythemis contaminata* Fab.	3	Plains of India
205	*Bradinopyga geminata* (Ram.)	1	Peninsular India.
206	*Orthetrum* sp.	3	. .
207	*Pantala flavescens* (Fab.)	1	All over India
	ORDER ORTHOPTERA		
	Fam. Acrididae		
208	*Acrida exultata* Wlk.	1	. .
209	*A. gigantea* Hbrt.	2	Nepal
210	*A. turrita* L.	5	All over India
211	*Aelopus affinis* Bol.	3	Madras, Bombay

Serial No.	Family and Species	No. collected	Distribution previously recorded
212	*Aelopus* sp.	1	..
213	*Aularches scabiosae* Fab.	1	Bombay, Orissa
214	*Catantops innotabilis* Wlk.	4	Assam, Bengal, Bombay
215	*C. pinguis* Stal.	4	Sikkim, Ceylon etc.
216	*Catantops* sp.	1	..
217	*Euparatettix parvus* Hanc.	2	Ceylon
218	*Euparatettix scabripes* Bol.	3	E. Bengal
219	*Euparatettix* sp.	1	..
220	*Euprepocnemis shirakii* Bol.	1	..
221	*Gastrimargus transversus* Thumb.	13	All over India
222	*Hedotettix gracilis* Haan.	1	
223	*Hieroglyphus banian* Fab.	7	Bombay Presidency and C. Provinces (Rice growing areas in this tract)
224	*Heteroacris illustris* Wlk.	1	South India
225	*H. insignis* Wlk. ?	2	Bengal, Madras
226	*Oxya velox* Fabr.	4	Assam, Bombay.
227	*Parella insignis* Bol. ?	1	..
228	*Parella* sp.	1	..
229	*Stauroderus* sp.	1	..
230	*Thisoicetrus adspersus* Rdt.	1	..
231	*Thisoicetrus* sp.	1	..
232	*Trilophidia annulata* Th.	1	Ceylon
233	*Xenocatantops humilis* Serv.	2	Assam, Bengal, Bombay
	Fam. Gryllidae		
234	*Brachytrypes orientalis* Bur.	1	All crickets common in the plains
235	*Gryllodes* sp.	4	
236	*Gryllus flavipes* Chap.	1	
237	*Gryllulus longipennis* S.	3	
238	*G. mitratus* Burm.	2	
239	*Gr.* sp. near *mitratus* Burm.	1	
240	*Gryllulus* sp.	14	
241	*Gryllotalpa africana* B.	4	
242	*Lucaropsis* sp.	1	
243	*Pteronemobius fascipes* Wlk.	1	
244	*Tridactylus thoracicus* Guer.	2	
	ORDER DICTYOPTERA		
	(Formerly Fam. Mantidae)		
245	*Aethalochroa ashmoliana* W.	5	Most are common all over India
246	*Creobroter gimmatus* (Stoll)	7	
247	*Gongylus gongylodes* L.	2	
248	*Hierodula tenuidentata* Serv.	3	
249	*H. unimaculata*	2	
250	*Humbertiella* sp.	3	

In addition to the above, a number of winged termites, mostly *Termes obesus* Ramb. and winged ants, *Dorylus orientalis* Westw. used to gather at the light. A crane fly (Tipulidae) *Pselliophora laeta* and a bug *Dalader acuticosta* Am. et. Serv. were caught in 1961.

Note added in proof

An additional 20 species have now been named by the Forest Research Institute, Dehra Dun and these are listed below

N.T.N.

Serial No.	Family and Species	No. collected	Distribution previously recorded
	ORDER COLEOPTERA		
	Fam. Erotylidae		
1	*Episcapha* sp.	1	..
	Fam. Scarabidae		
2	*Aserica staturosa* Br.	6	Common in India
3	*Lachnosterna serrata* F.	2	do.
4	*Trichogomphus* sp.	2	..
	Fam. Staphylinidae		
5	*Paederus* sp.	1	..
6	*Platystethus indicus* C.	3	Dehra Dun
7	Staphylinid sp.	1	..
	ORDER DIPTERA		
	Fam. Calliphoridae		
8	*Lucilia* sp.	4	
	Fam. Muscidae		
9	*Musca domestica* L.	1	Universal
	Fam. Stratiomyidae		
10	*Sargus* sp.	2	..
	Fam. Tabanidae		
11	*Tabanus* sp.	2	..
	Fam. Tachinidae		
12	*Tachinid* sp.	1	..
	Fam. Tipulidae		
13	*Conosia irrorata* Wied.	2	..
14	*Libnotes punctipennis* M.	1	..
15	*Tipula* sp.	3	..
	Fam. Trypetidae		
16	*Rioxa dunlopi* Wulp.	1	Sylhet, Kharagpur.
	ORDER HYMENOPTERA		
	Fam. Braconidae		
17	*Braconid* sp.	1	..
	Fam. Formicidae		
18	*Camponotus compressus* Fab.	3	Cosmopolitan
	Fam. Ichneumonidae		
19	*Ambyteles* sp.	3	..
	ORDER NEUROPTERA		
	Fam. Mantispidae		
20	*Mantispa* sp.	1	..

Littoral and Parasitic Isopods from Kerala: Families Eurydicidae, Corallanidae and Aegidae—2

BY

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(*With two plates and seven text-figures*)

[*Continued from Vol.* **63** (1): 161]

This is the second part of the series and deals with the families Eurydicidae (Cirolanidae), Corallanidae and Aegidae. In all, fourteen species are described. Though the collection contains no new species, it is extremely interesting as it throws light on the progressive evolution of the parasitic habit among the flabelliferan isopods.

Menzies, Barnard and Alverson (1955) dealt at length with the evolutionary and ecological relationship of the flabelliferan families and concluded that the primitive flabelliferan must have been more or less like the present day cirolanids. This primitive stalk got split into two groups, one retained the free living mode of life and developed into the Cirolanidae and the other gave rise to the aegid stalk. The latter in turn evolved into the Aegidae on the one hand and into the Cymothoidae on the other. That this conclusion is substantially correct has been shown by the present study.

The families Cirolanidae (Eurydicidae), Corallanidae, Aegidae and Cymothoidae are closely related and, with regard to parasitic propensity, form a very natural series. At present all the known species of cirolanids are free living but extremely carnivorous. Corallanids are predominantly free living and like the cirolanids carnivorous. But a very small number exhibit parasitic tendency. For instance, *A. rhinoceros* has been recorded as a parasite. During the present study a large number of specimens of *A. normani*, hitherto known only as free living, were collected along with *A. rhinoceros*, from the nostrils of the perch, *Epinepheles chlorostigma.* It is also significant, in this context, that Bal & Joshi (1959) recorded *A. muraenae* as a true parasite.

Aegids are predominantly parasitic and even among the free living members parasitic tendency is evident. During the present study, two species, *Barybrotes indus* and *Alitropus typus*, were observed to show parasitic habit. The former was collected in large numbers from the gill slits and the cloacal aperture of the devil ray, *Mobula diabolus*. Two specimens of *Alitropus typus* were collected from the gill cavity of *Etroplus suratensis*. To get further evidence I introduced a single *Polycanthus cupanus* into an aquarium tank containing a few specimens of *Alitropus typus*. The isopods were seen to get attached to the fish on and off. Both *Barybrotes indus* and *Alitropus typus* are fully equipped for an active free swimming life but exhibit unmistakable signs of becoming parasites. A good many of the present day free living flabelliferans show parasitic tendency and their progressive evolution along this line is, therefore, natural.

Family EURYDICIDAE

Only two genera, *Eurydice* Leach and *Cirolana* Leach are represented in the present collection. In *Eurydice* the basal peduncular segment of the first antenna is expanded and the fifth pleon segment is laterally exposed. In *Cirolana* the first peduncular segment of first antenna is not expanded and the fifth pleon segment is overlapped by the fourth.

Eurydice Leach

Eurydice inermis Hansen (Fig. 1, A-I)

Eurydice inermis Hansen, 1890, p. 366 ; 1906, p. 369, pl. 35, figs. 3a-c.

Remarks. *E. inermis* has so far been recorded only from European waters. The specimens in the present collection so exactly correspond to the description given by Hansen, that there is no doubt about their identity. This species can be distinguished by the shape and armature of the telson. The telson is as long as broad, with the lateral borders serrate at the distal half. The serrations slightly increase in size towards the apex. The distal border of the telson is nearly subtruncate and only one-fourth the total width of the telson and is armed with nine teeth The extreme lateral teeth and the median tooth are larger than the others.

Body is white with a greyish mottling due to the presence of profusely branched chromatophores.

Length 5·0 mm.

This species occurs in the inshore plankton collections in moderate numbers.

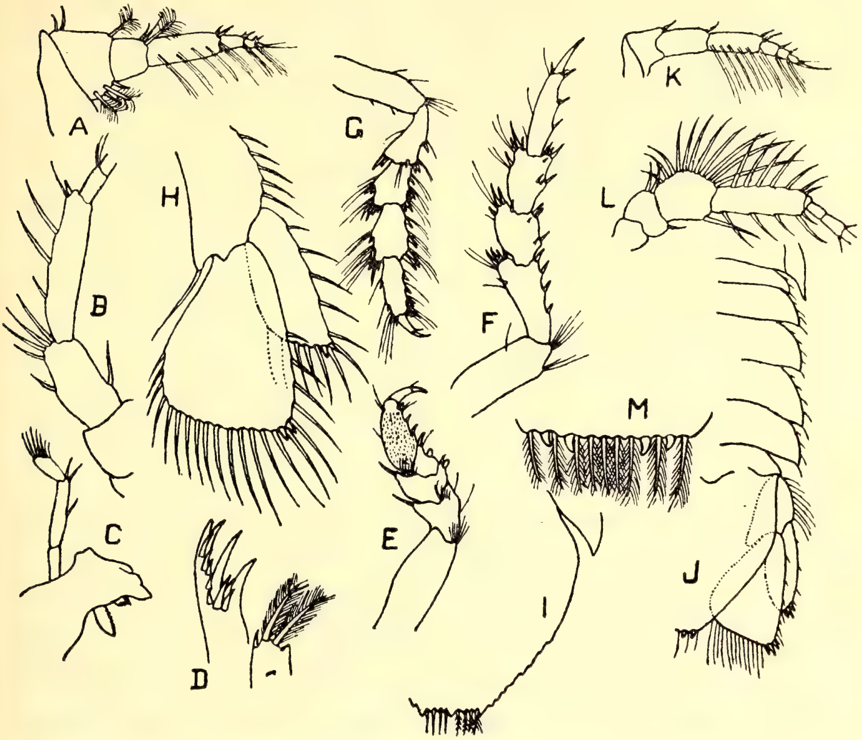

FIG. 1. A-I, *Eurydice inermis* Hansen. A. antennule; B. antenna; C. mandible; D. maxillule; E. first leg; F. sixth leg; G. seventh leg; H. uropod; I. telson. J-M. *Eurydice pulchra* Hansen. J. pleon and telson; K. antennule; L. antenna; M. distal border of telson.

Eurydice pulchra Hansen (Plate I, 1; Fig. 1, J-M)

Eurydice pulchra Hansen, 1890, p. 370, pl. 4, figs. 3a-i; G.O. Sars, 1899, p. 73 pl. 30, f.2; Hansen, 1905, p. 365, pl. 34, f.3 and pl. 35, f.1.

Remarks. Like *E. inermis*, *E. pulchra* has so far been recorded only from European waters. The telsonic apex is very characteristic of this species. Its truncated distal border is one-third the maximum width and is crenulate. There are two pairs of widely separated spines. The dorsal side of the telson has a deep crescentic proximal median groove flanked by shallow grooves. *E. pulchra* closely resembles *E. affinis* Hansen. But in the latter species the distal border of the telson is defined by a pair of conspicuous spines.

Length 4·0 mm.

This species sparingly occurs in the inshore plankton.

Cirolana Leach

The three species described here belong to the group with the posterior peraeon segments and the pleon armed with spines. They can be distinguished by the following key:

1. Dorsal surface of telson without spines ... *willeyi*
   Dorsal surface of telson with spines ... 2
2. Telson with a pair of large submedian basal spines ... *bovina*
   Telson with a pair of submedian rows of spines ... *fluviatilis*

Cirolana willeyi Stebbing (Fig. 2, A-B)

Cirolana willeyi Stebbing, 1904, p. 11, pl. 3 ; Barnard, 1935, p. 312 ; Pillai, 1961 p. 45, fig. 21, 1-2.

Cirolana nigra Chilton, 1924, p. 884, pl. 9, f.3, t. fig. 6.

Remarks. This species can be distinguished by the following characters. Posterior border of peraeon segments two to seven is armed with small spines, fifteen on the fifth, eleven on the sixth and thirteen on the seventh. Pleon segments two to four have five teeth each and the fifth has three, the odd median tooth on each segment is larger than the rest. Dorsal surface of the telson is devoid of spines. Frontal lamina is narrow and long with straight antero-lateral sides, its antero-median part forms an acute angle. Appendix masculina of seventh peraeon segment is a pair of mammiform papillae.

Length 10·0 mm.

This species is very abundant in Kerala, particularly in brackish water localities.

Distribution. Ceylon, Chilka Lake and Kerala.

Cirolana fluviatilis Stebbing (Fig. 2, C-D)

Cirolana fluviatilis Stebbing, 1902, p. 52 ; Barnard, 1920, p. 346 ; 1935, p. 310 f. 19 ; 1940, p. 395 ; Pillai, 1961, p. 47, figs. 21, 3-4.

Cirolana pleonastica Chilton, 1924, p. 882, pl. 60, f.2 ; 1926, p. 180, f.2.

Cirolana bicarinata Pillai, 1954, p.6.

Remarks. Like *C. willeyi* this species is very abundant in the estuarine localities in Kerala. It is more slender than *C. willeyi* and is devoid of the black pigmentation which is very characteristic of *C. willeyi*. Peraeon segments four to seven are armed with spines, the seventh segment has thirteen teeth. Fifth pleon segment has five teeth, the median tooth is slightly larger than the others. The dorsal side of the telson has two submedian teeth followed by two parallel rows of three to four denticles forming a pair of short ridges.

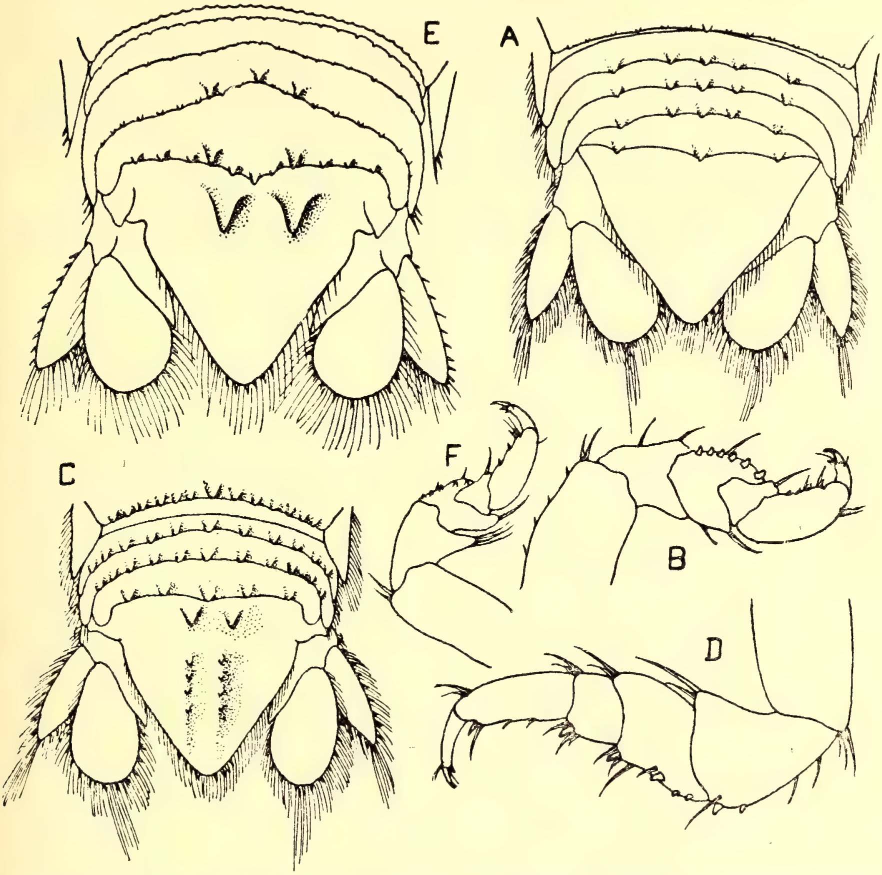

FIG. 2. A-B, *Cirolana willeyi* Stebbing. A. pleon and telson ; B. first leg. C-D, *Cirolana fluviatilis* Stebbing. C. pleon and telson ; D. first leg. E-F. *Cirolana bovina* Barnard. E. pleon and telson ; F. first leg.

Length 9·0 mm.

Distribution. South Africa, Siam and India.

Cirolana bovina Barnard (Plate I, 2; Fig. 2, E-F)

Cirolana bovina Barnard, 1940, p. 400, figs. 9 c-d ; Pillai, 1961, p. 47, f.22.

Remarks. In the female the body is roughly oblong, but is longer and nearly parallel sided in the male. Peraeon segments do not carry distinct spines, but the hind margin is feebly crenulate.

Hind border of pleon segments two to five is denticulate, second to fourth are armed with twenty teeth and fifth with eleven teeth, three of the teeth on fourth segment and two on the fifth are larger than the rest and project beyond the border. Dorsal side of the telson has a pair of large, submedian conical teeth to which the specific name alludes. Frontal lamina is pentagonal and slightly longer than broad. Stylet on second male pleopod is slender and apically bent outwards, considerably longer than the endopod.

Length 15·0 mm.

This species is very abundant in the littoral waters of Kerala, and, unlike the other two species, is exclusively marine.

Distribution. South Africa.

Family CORALLANIDAE

Three genera, *Corallana*, *Lanocira* and *Argathona* are represented in the present collection. They can be distinguished by the following key:

1. First segment of peduncle of first antenna expanded, second segment of maxilliped much longer than broad, seventh segment short ... *Corallana*
   First segment of peduncle of first antenna not expanded, second segment of maxilliped only slightly longer than broad ... 2
2. First maxilla strongly falcate ... *Lanocira*
   First maxilla moderately falcate ... *Argathona*

Corallana Dana

Corallana nodosa Schi. & Mein. (Plate II, 1; Fig. 3)

Corallana nodosa Schi. & Mein., 1879, p. 294, pl. 5, figs. 8-9; Hansen, 1890, p. 389; Stebbing, 1904, p. 14, pl. 1B; Pillai, 1961, p. 49, f.23.

Remarks. This well-known species can be easily recognised by the following characters. In the male the cephalon has a pair of large horns placed at right angles to the surface of the head, just in front of the eyes. Peraeon segments five and six carry two pairs of large posterior submarginal teeth projecting far beyond the hind border of the respective segments, the outer member of each pair is larger than the inner. The seventh peraeon segment has a single pair of spines. Pleon segments two to four carry a large spine in the middle of each half and the distal border of the segment outer to this spine is crenulate. The apex of the telson forms an independent triangle. Basal segment of the peduncle of the antennule is vertically expanded and over-reaches the cephalic horns. Maxilliped is seven-segmented, second segment is very long and the seventh is very short. First maxilla has a slender curved unguis and a small inner lobe.

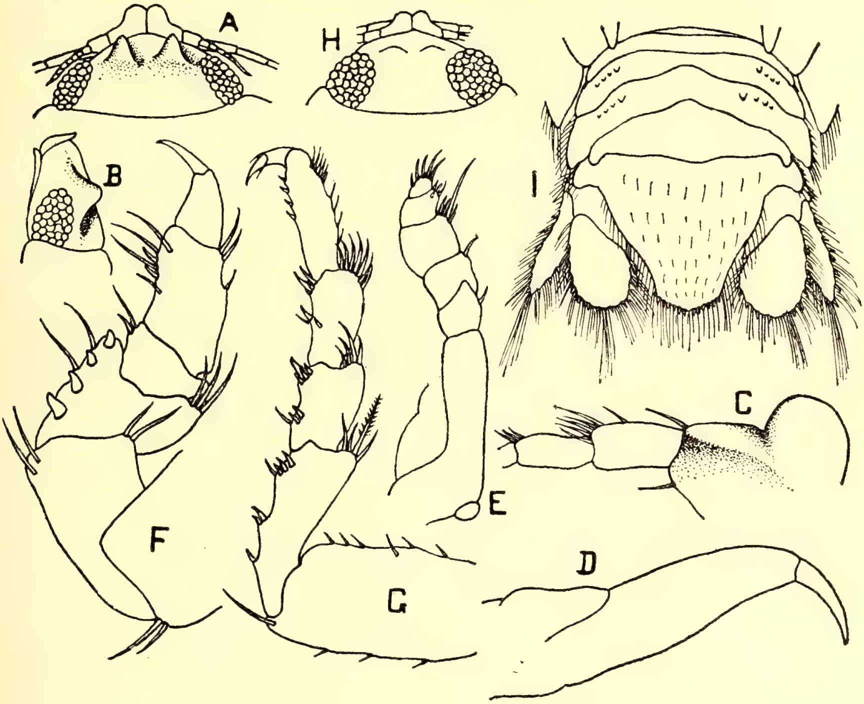

FIG. 3. *Corallana nodosa* Schi. & Mein. A-G. male ; A. cephalon, dorsal view ; B. same, lateral view ; C. antennule ; D. maxillule ; E. maxilliped ; F. first leg ; G. seventh leg ; H-I. female ; H. cephalon, dorsal view ; I. pleon and telson.

The female differs from the male in the less setose body, the cephalic horns are very small and the spines on the peraeon and pleon segments are comparatively very small. The female is uniformly grey due to the presence of numerous highly branched black chromatophores. In the male brick red chromatophores are mixed with the black ones giving it a brownish tint.

Length of male 10·0 mm., of female 8·0 mm.

In the present locality this species has been collected only from brackish water.

Distribution. Philippines and Ceylon.

Lanocira Hansen

The three species contained in the present collection can be distinguished by the following key:

1. Cephalon in the male produced into a dorsally curved rostrum	...	*gardineri*
Cephalon not produced into a rostrum	...	2
2. Telson broadly rounded, coxal plates large and projecting	...	*rotundicauda*
Telson nearly triangular, coxal plates small and not projecting	...	*zeylanica*

Lanocira gardineri Stebbing (Plate I, 3; Fig. 4, A-H)

Lanocira gardineri Stebbing, 1904, p. 706, pl. 51A ; 1905, p. 19 ; Barnard, 1914, p. 359, pl. 31A.

Remarks. This species can be easily distinguished by the apically curved rostrum and the presence of two low elevations just inner to the eyes on the cephalon of the male. The surface of the cephalon between the eyes is concave. *L. gardineri* shows sexual dimorphism. The rostrum is absent in the female and the first antenna is less feathery than in the male.

Length 7·5 mm.

Moderately common in the littoral waters of Kerala.

Distribution. Maldive Islands, Ceylon and South Africa.

Lanocira rotundicauda Stebbing (Plate I, 4; Fig. 4, I-O)

Lanocira rotundicauda Stebbing, 1905, p. 708 ; Nierstrasz, 1931, p. 169 ; Pillai 1954, p. 7.

Remarks. Since its creation, this species has never been redescribed. Stebbing himself suspected that *L. rotundicauda* might be the female of *L. gardineri.* The present collection contains both males and females of *L. gardineri* and the female is very different from *L. rotundicauda. L. rotundicauda* can be easily distinguished from *L. gardineri* by the absence of a rostrum, presence of large projecting coxal plates, the comparatively short and roughly semicircular telson, by its broader frontal lamina and by the absence of an accessory lobe on the mandible. The two species differ also in size, *L. gardineri* reaches a length of 7·5 mm., while the fully adult female of *L. rotundicauda* is only 6·0 mm.

Distribution. Maldive and Laccadive Archipelagos.

Lanocira zeylanica Stebbing (Plate I, 5; Fig. 4, P-R)

Lanocira zeylanica Stebbing, 1905, p. 20, pl. 5B; 1910, p. 219.

Remarks. All the species of *Lanocira* described here occur together and resemble each other to some extent that it is not easy to distinguish them. *L. gardineri*, as stated earlier, has a rostral prolongation in the male and *L. rotundicauda* has large projecting

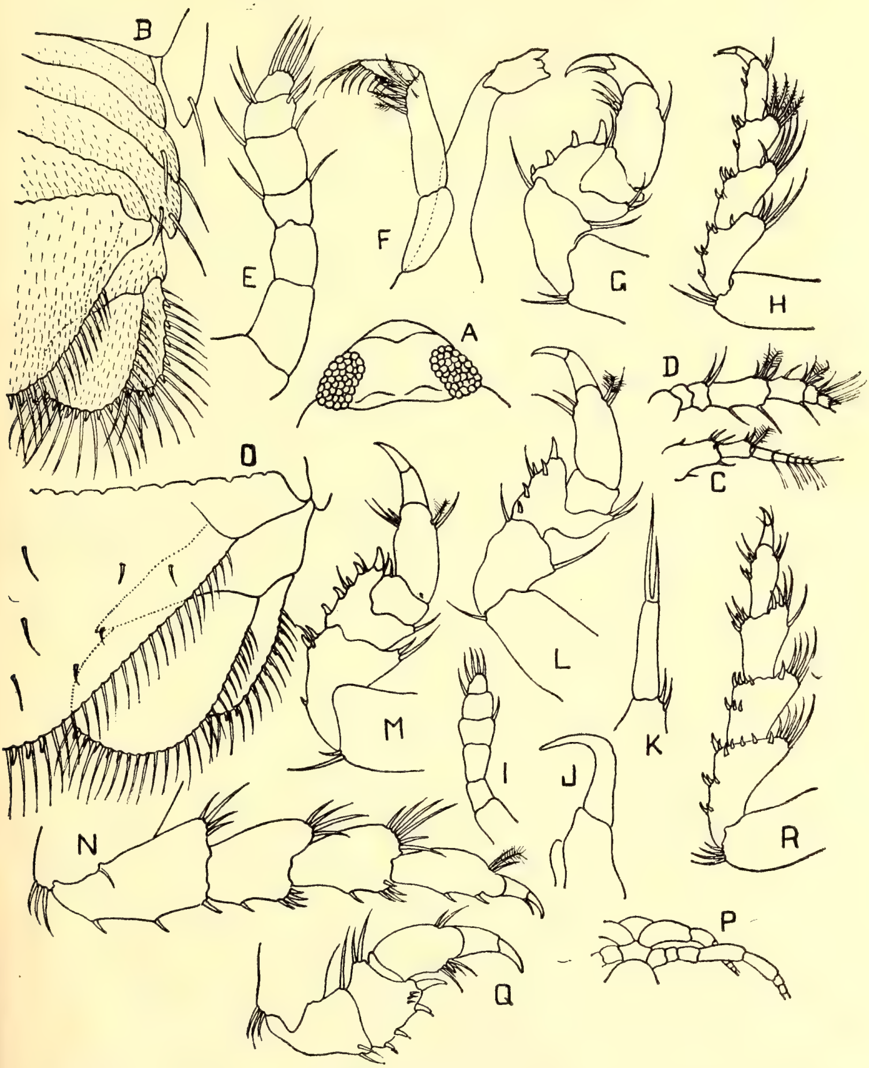

FIG. 4. A-H. *Lanocira gardineri* Stebbing. A. cephalon ; B. pleon and telson ; C. antennule ; D. antenna ; E. maxilliped ; F. mandible ; G. first leg ; H. seventh leg ; I-O. *Lanocira rotundicauda* Stebbing ; I. maxilliped ; J. maxillule ; K. maxilla ; L. first leg ; M. second leg ; N. seventh leg ; O. telson and uropod ; P-R. *Lanocira zeylanica* Stebbing ; P. frontal lamina ; Q. first leg ; R. seventh leg.

coxal plates. *L. zeylanica* differs from both in the presence of a submarginal groove on the cephalon (not shown in the figure) which is, however, difficult to observe, by the short coxal plates and the very short fifth segment of the first peraeopod. There is recognisable difference in the peraeopods of the three species.

Distribution. Ceylon and Red Sea.

Argathona Stebbing

Argathona rhinoceros (Bleeker) (Fig. 5, G-I)

Argathona rhinoceros Stebbing, 1910, p. 100, pl. 9A; Monod, 1933, p. 175 1934, p. 9.

Remarks. The large curved rostrum easily distinguishes this species from all the others. As other distinguishing characters may be mentioned the smooth body and the pentagonal frontal lamina. First maxilla has a small tooth at the base of the unguis and the broad, apically truncate inner lobe carries a small inner spine. The maxilliped is short but stout and six-segmented.

Length 10·0 mm.

A large number of specimens were collected from the nostrils of *Epinepheles chlorostigma* caught on hooks at nearly 50 fathoms off Quilon.

Distribution. Zanzibar, Aldabra Ceylon, Java and Indo-china.

Argathona normani Stebbing (Fig. 5, A-E)

Argathona normani Stebbing, 1905, p. 17, pl. 3A; Barnard, 1936, p. 156.

Remarks. This species can be recognised by the extremely hirsute body and the presence of tubercles on the dorsal side. The full complement of tubercles, mentioned by Stebbing, was not observed but the two lateral pairs on the fourth pleon segment, two large submedian ones on the fifth pleon segment and two pairs on the proximal part of the telson are clear. Perhaps, as observed by Barnard, the others are present but indistinguishable.

In the specimens dissected, the maxilliped showed only five segments. The second segment is long and carries a seta in the middle of its inner border. This probably represents the position where two segments might have fused. It should be noted that in *A. rhinoceros* the maxilliped is six-segmented. The first maxilla of *A. normani* has two spines at the base of the unguis.

Length 7·0 mm.

Several specimens were collected along with *A. rhinoceros.*
Distribution. Ceylon and Bay of Bengal.

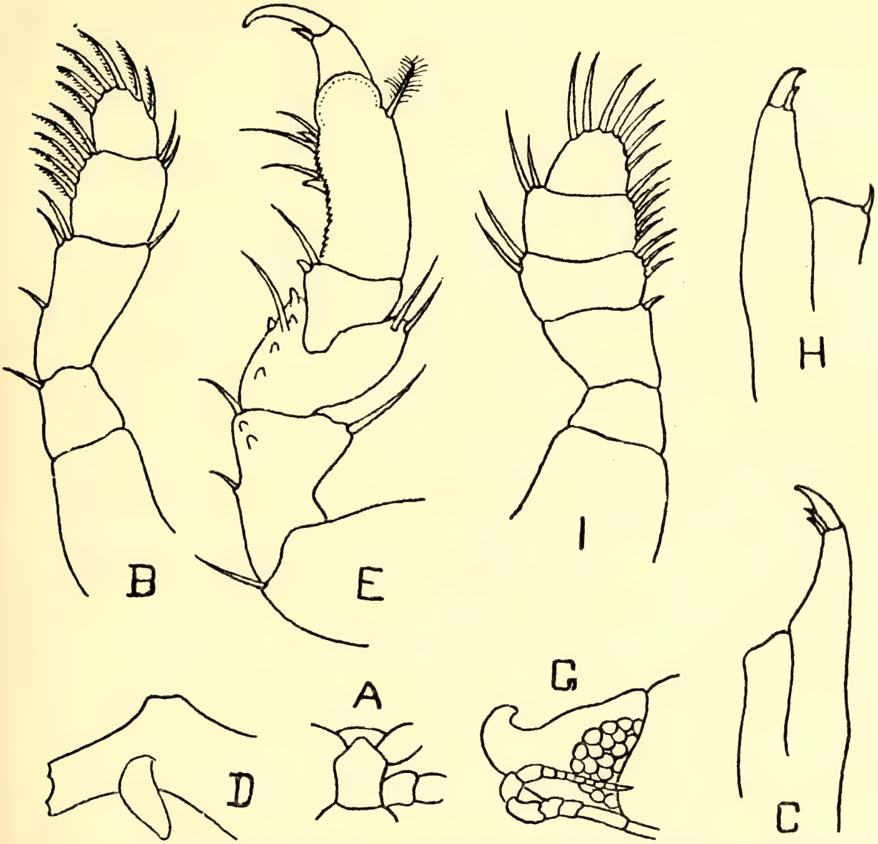

FIG. 5. A-E. *Argathona normani* Stebbing. A. frontallamina ; B. maxilliped ; C. maxillule ; D. tip of mandible ; E. first leg ; G-I. *Argathona rhinoceros* (Bleeker); G. cephalon, lateral view ; H. maxillule ; I. maxilliped.

Family AEGIDAE

The three genera, *Barybrotes*, *Rocinela* and *Alitropus*, contained in the present collection can be distinguished by the following key:

1. Median point of head separates the bases of the first antennae, maxilliped six to seven-segmented ... *Barybrotes*
   Median point of head covering the bases of the first antennae, maxilliped not more than two-segmented ... 2

2. Sixth segment of anterior peraeopods expanded and with strong spines ...	*Rocinela*
Sixth segment of anterior peraeopods not expanded, without strong spines ...	*Alitropus*

Genus **Barybrotes** Schi. & Mein.

Barybrotes indus Schi. & Mein. (Plate II, 2; Fig. 6)

Barybrotes indus Schi. & Mein., 1879, p. 281; Monod, 1934, p. 10, pls. 11-17; Barnard, 1936, p. 157.

Remarks. This well-known species has been illustrated in detail by Monod (1934). The more important characters alone are pointed out here. The cephalon is semicircular, with a small anteromedian process projecting between the bases of the first antennae.

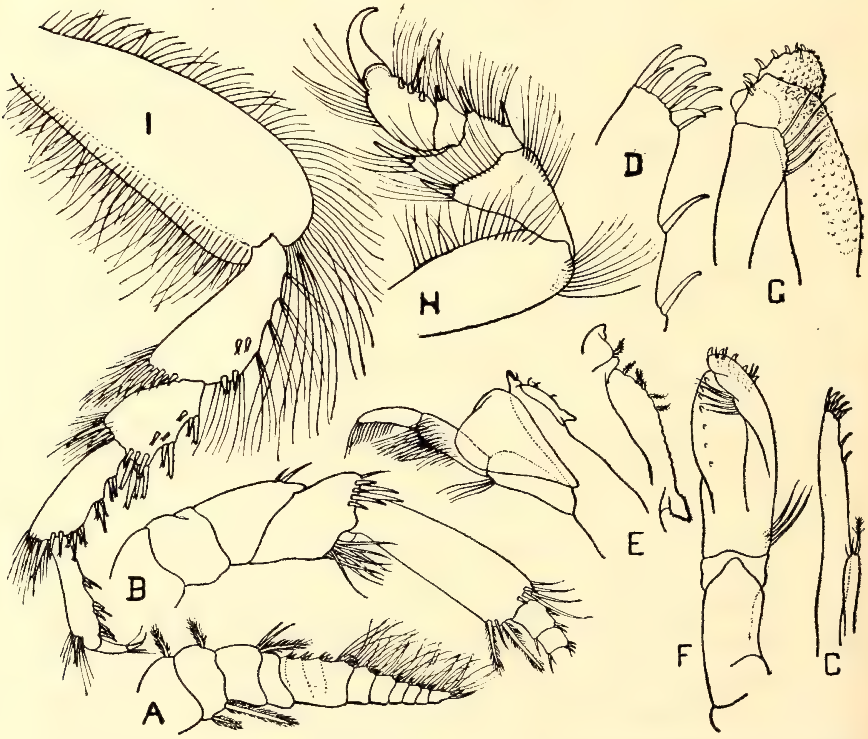

Fig. 6. *Barybrotes indus* Schi. & Mein. A. antennule; B. antenna; C. maxillule; D. same, tip enlarged; E. mandible; F. maxilliped; G. same, inner view; H. first leg; I. seventh leg.

Eyes are large and reniform. Peraeon segments four to six are large, with a prominent lateral groove running inwards. Telson is elongate-triangular and dorsally arched, its apex, in fully grown specimens, is subtruncate and armed with six strong spines. Basal segment of the peduncle of the first antenna is expanded and visible in the dorsal view of the animal, flagellum is seven-segmented but the basal segment appears to be formed by the fusion of at least four segments. Mouth parts and peraeopods are as illustrated by Monod, but the setae on the second segment of the posterior peraeopods are longer than in Monod's specimens. Frontal lamina is club-shaped. Inner lobe of the first maxilla has a pair of setae at the base of the large seta.

Only two species, *B. indus* Schi. & Mein., and *B. agilis* Schi. & Mein., have hitherto been recorded. According to Stebbing these two are synonymous and the name *indus* has precedence. The genus is hence monotypic.

Length 20·0 mm.

The collection includes nearly sixty specimens from the gills of *Mobula diabolus* caught at Vizhingam.

The body is white but the gut content is visible as a dark stony mass.

Distribution. Bay of Bengal, Java, Gasper Strait, South China, Philippines, Indochina and India.

Genus **Rocinela** Leach

Rocinela orientalis Schi. & Mein. (Plate II, 5; Fig. 7, E-F)

Rocinela orientalis Schi. & Mein., 1879, p. 395, pl. 13, figs. 1-2 ; Stebbing, 1905, p. 24, pl. 6B ; Barnard, 1914, p. 368 ; Hale, 1925, p. 182, f. 27 ; Barnard, 1936, p. 160.

Remarks. The single specimen in my collection closely resembles the Ceylon specimens described by Stebbing. The 'fovea' on the head, observed by Hale, is present (not shown in the figure).

To date four species of *Rocinela* have been recorded from this region. As observed by Barnard (1936), *R. latis* Southwell is the young of *Nerocila*, *R. mundana* Lanchester (1902) is synonymous with *R. simplex* Chilton (1926) which is an *Alitropus* and not a *Rocinela* (*vide infra*). Thus the only species known from India is *R. orientalis* Schi. & Mein.

Length 10·9 mm.

Distribution. Philippines, Ceylon, Suez Canal, Zanzibar, Natal, Torres Strait, Morten Bay, Queensland and India.

Genus **Alitropus** M. Edwards

Alitropus typus M. Edwards (Plate II, 3-4; Fig. 7, A-D, G)

Alitropus typus M. Edwards, 1840, p. 263 ; Martens, 1868, p. 59 ; Schi. & Mein 1879, p. 405 ; Weber, 1892, p. 553 ; Stebbing, 1911, p. 181 ; Ingle & Fernando, 1963, p. 106, f.4.

Rocinela mundana Lanchester, 1902, p. 363.

Rocinela orientalis Chilton, 1924, p. 886.

Rocinela simplex Chilton, 1926, p. 182, figs. 4 a-m.

Alitropus dimorphus Pillai, 1954, p. 8.

Male. Body is comparatively slender and elongated, about three times as long as broad. Head is broadly triangular, with the antero-median part slightly produced. Eyes are large. First peraeon segment is the narrowest, segments one to four successively increase

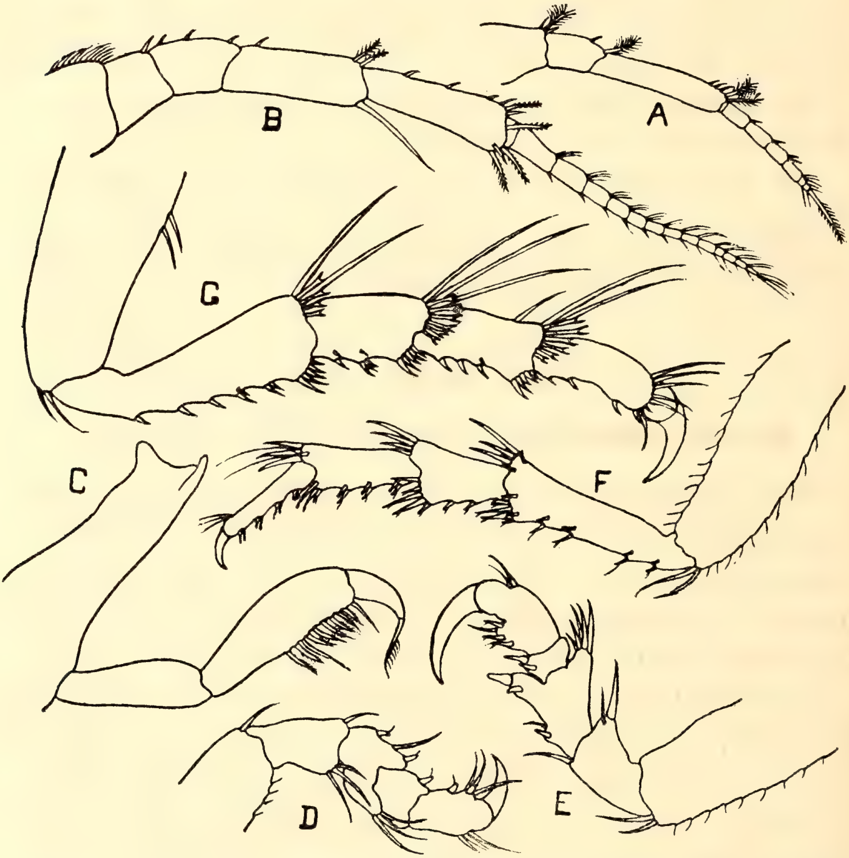

Fig. 7. E-F. *Rocinela orientalis* Schi. & Mein. E. first leg ; F. seventh leg ; A-D and G. *Alitropus typus* M. Edwards. A. antennule ; B. antenna ; C. mandible ; D. first leg ; G. seventh leg.

in length. Antero-lateral corners of first segment are slightly produced forwards and the postero-lateral corners of all the segments are angular. Peraeon segments five to seven are subequal in size, abruptly longer than the fourth segment, sixth segment is slightly longer and broader than all the others. Coxal plates are well developed and produced but not over-reaching the posterior border of the respective segments, each has an outer row of setae. All the five pleon segments are clearly visible, abruptly narrower than the peraeon and slightly immersed in it, lateral parts of segments one to four are drawn out into acute processes, fifth segment is the narrowest. Telson is semicircular, with broadly rounded distal border, in very large specimens the distal border of the telson tends to be broadly triangular, with a subtruncate apex.

First antenna is as long as the peduncle of the second, third peduncular segment is slender and as long as the first two segments combined, flagellum is six-segmented, sixth segment terminates in a long seta. Second antenna over-reaches the second peraeon segment, flagellum is thirteen-segmented.

Second segment of the palp of the mandible is very large, with a comb of stout pectinate setae, third segment is comparatively small, with a single apical seta. First maxilla has a short apical tooth and two long inner spines. Inner lobe of second maxilla has three spines, margin of the outer lobe is serrated. Outer border of maxilliped is hairy, its apex carries three spaced spines. Fifth segment of first peraeopod is slightly immersed in the fourth, sixth segment is cylindrical and not flattened as in *Rocinela*, dactylus is short and falcate. Posterior peraeopods are slender and long, with the lower border of the segments prominently spiny, upper distal angle of segments three to five with a row of stout branched spines and long setae. Peduncle of the second pleopod has six hooks, stylet is shorter than the endopod and carries a small apical spine. Exopod has a series of spots as in *Rocinela simplex* Chilton. Peduncle of the uropod is produced and reaches beyond two-thirds of the length of the endopod, endopod is apically rounded and armed with seven spines, exopod is narrow and long, with seven spines.

Length 13·0 mm., breadth 5·0 mm.

Body is dark grey with profusely branched chromatophores.

Female. Body is comparatively broader than that of the male, twice as long as broad. First peraeon segment is as long as the head, segments five to six are much shorter than in the male, postero-lateral corners of the segments are not acute. Coxal plates are comparatively broad, with rounded apex. Pleon is very short, as broad as peraeon, segments one to four are equal in length and breadth.

Length 15·0 mm., breadth 7·0 mm.

This is a very common species found in fresh water and also in slightly brackish water. If introduced into an aquarium tank it shows a tendency to cling on to the body of fishes.

Distribution. Siam, Borneo, Sumatra, India and Ceylon.

Remarks. In the illustrations given by Chilton (1926), figure 4a is described as that of the female and figure 4d as that of an immature male. There appears to be a slight confusion. Figure 4a is that of an adult male and figure 4d that of an immature male or female. Chilton appears to have been unaware of the sexual dimorphism which this species shows. Figure 4k is likely to be that of the second pleopod of the specimen marked 4a and not of 4d.

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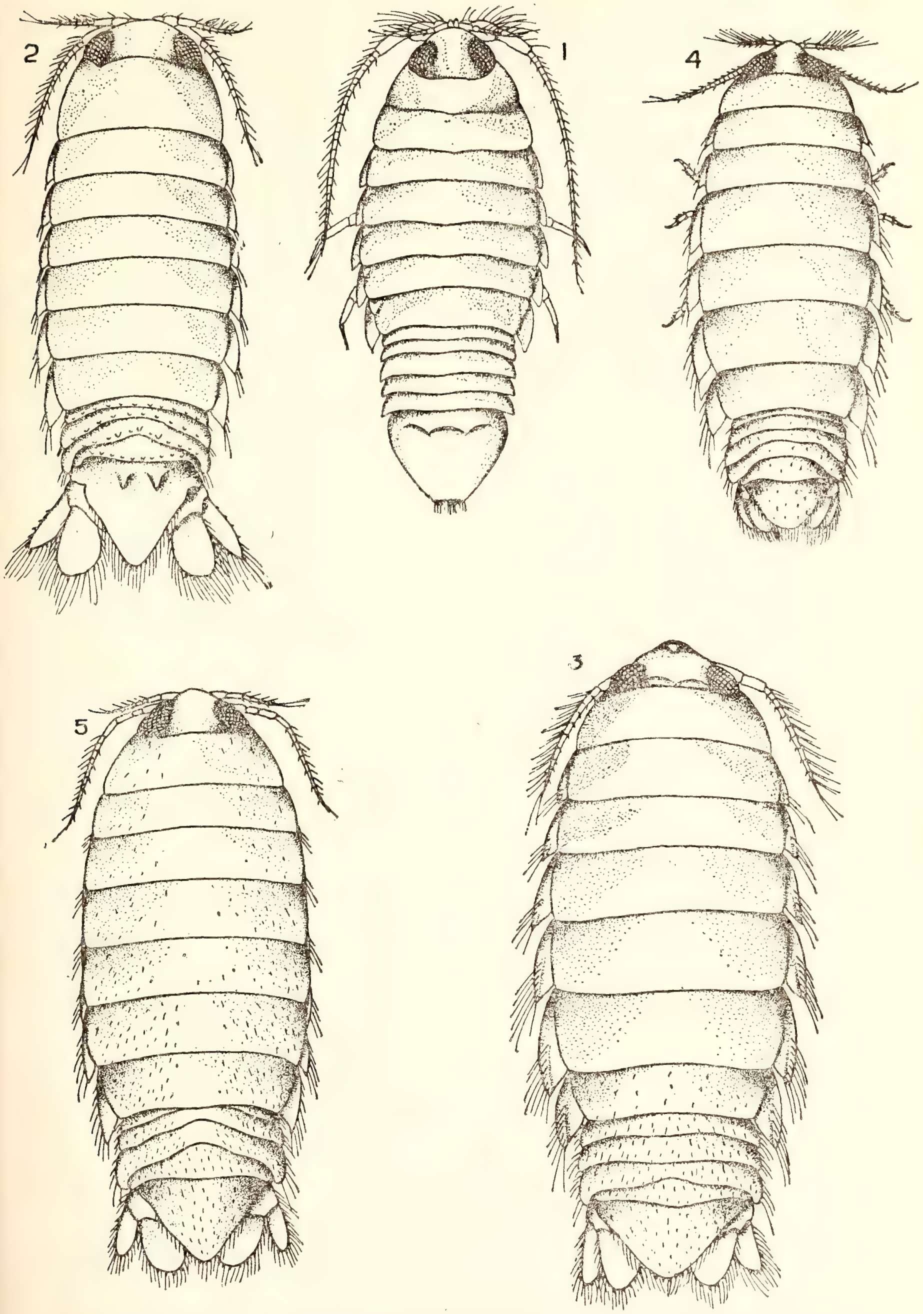
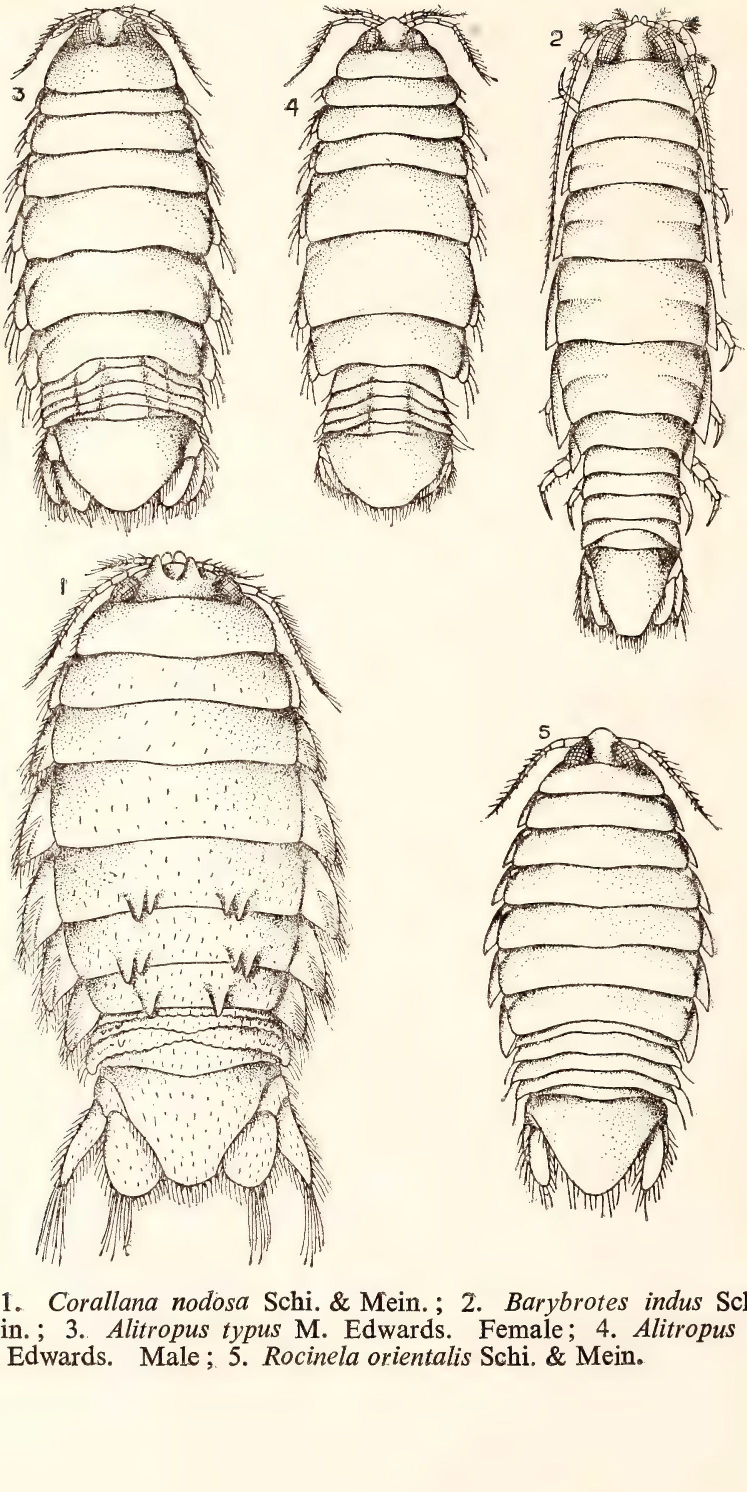


1. *Eurydice pulchra* Hansen ; 2. *Cirolana bovina* Barnard ; 3. *Lanocira gardineri* Stebbing ; 4. *Lanocira rotundicauda* Stebbing; 5. *Lanocira zeylanica* Stebbing.



1. *Corallana nodosa* Schi. & Mein.; 2. *Barybrotes indus* Schi. & Mein.; 3. *Alitropus typus* M. Edwards. Female; 4. *Alitropus typus* M. Edwards. Male; 5. *Rocinela orientalis* Schi. & Mein.

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Notes on the Nidification of the Pied Harrier, *Circus melanoleucos* (Pennant), in Amurland, U.S.S.R.

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(*With four plates*)

The Pied Harrier, *Circus melanoleucos* (Pennant), is a rather common visitor to India. As a breeder, it is now practically confined to the north-east of the country, to Assam, an area isolated from the main nesting range.

In many of its habits the Pied Harrier resembles other Harriers wintering in India, and often associates with them. Adult males can be easily recognised by the distinctive black and white plumage, differing from other species of the genus (Plate I, *above*). The breeding biology is still insufficiently known, although the bird is rather common in the northern parts of its range.

This paper is based mainly on data gathered by the authoress during her expeditions to Amurland (SE. Siberia, U.S.S.R.) in 1957-1959 and 1961-1962.

GEOGRAPHICAL DISTRIBUTION

In the Soviet Union the Pied Harrier is a common summer resident of the plains and wide river valleys in the Primorye Territory (Ussuriland), Amurland, and Transbaikalia. The breeding range in the U.S.S.R. is as follows: according to L. Shulpin (1936) and K. Vorobiev (1954) it is common in the southern parts of the Sikhote-Alin Range (the valley of Suchan River), but has never been seen on the eastern slopes of the range. The easternmost point of its range in the valley of Amur River is village Padali near the city of Komsomolsk (Kistyakowsky, Loskot & Smogorzhewsky 1962). North of the Amur it was found at Bureya River near village Ostrovnoe (Kistyakowsky & Smogorzhewsky 1963) and at Zeya River near Zeya town (Collection of the Zoological Institute). The western part of the north boundary of the breeding range is still unclear. At any rate the Pied Harrier is known from the town of Skovorodino (the authoress's observations), the lower course of Argun River, the towns of Sretensk and Darasun (Radde 1863; Taczanowski 1872; Gagina 1961). The Pied Harrier occurred casually in some places along the eastern coast of Lake Baikal (Verkhnya Angara River, Barguzin River, the delta of Selenga River, and the valleys of Irkut and Djida rivers) but breeding there was not proved (Gagina 1954, 1960 a, b; Izmailov 1958).

Outside the limits of the Soviet Union it inhabits most parts of NE. China (Manchuria) and the northern parts of Inner Mongolia (Ingram 1909; Kuroda 1918, 1931; Meise 1934; Yamashina 1939; Caldwell 1931; Piechocki 1958). From NE. China it probably penetrates to N. Korea (Austin 1948). According to T. H. Shaw (1936), the Pied Harrier visits Hopei province during autumn and spring migrations only, though two males he mentioned in his book were collected near Peking on 8th May, i.e. they could be breeding birds. The Pied Harrier was met in the north-eastern parts of the Mongolian Republic—along the lower course of Kerulen River and on the shores of Lake Buir-Nor (Tugarinov 1932). The southernmost breeding places of the Pied Harrier known are widely separated from the main range, being located in N. Burma (Myitkyina) and the adjoining plains of Assam (Cripps 1882; Hume 1888; Baker 1935; Stanford 1935; Smythies 1953). H. Harington (1903) has observed these birds in the south of Shan State (Burma) on 10 and 28 July. He supposed them to be breeding birds.

Evidently the Pied Harrier has two widely divided breeding areas. Very probably, this disjunction arose within historical times. The vast plains of central and south China have been cultivated for thousands of years, and in the process the breeding habitats of the Pied Harriers were probably destroyed and turned into fields.

Throughout its range the Pied Harrier is a migratory bird. A part of the southern population may be resident but more probably they undertake short distance regular seasonal movements. According to W. Legge (1880) the female collected in March in Ceylon had her gonads enlarged as if breeding was to commence very soon. This suggests that the breeding area of birds wintering in Ceylon is not far from that island, perhaps in Assam or Burma. According to I. Kalinowski's observations (Taczanowski 1893), the Pied Harrier sometimes winters in small numbers in S. Ussuriland. G. Wilder and H. Hubbard (La Touche 1932) saw them till December or even January in N. China during several years. In winter this harrier can be seen over rice-fields, bogs, and wet meadows in all parts of India, and it is only in the north-western and central States that it was rather seldom seen. The Pied Harrier is known as a winter visitor to East Pakistan and as a rare vagrant in West Pakistan; it happens that it stays in Nepal; it is very common and widely distributed at non-breeding time in the plains of S. Burma, in the grass marshes and rice fields of Thailand and in similar habitats throughout Indo-China and Malacca; in S. China it was recorded in winter in Yunnan, Kwangsi, Kwangtung, Fohkien, etc.; it is seen irregularly in swampy plains with small bushes and trees on the NW. coast of Ceylon; the southernmost points are Borneo and Philippines (Jerdon 1862; Bingham 1880; Legge 1880; Davison 1883; Oates 1883; Hume 1888; Donald 1905; Baker 1928; Caldwell 1931; Hachisuka 1934; Stanford 1935; Whistler & Kinnear 1936; Deignan 1945; Delacour & Mayr 1946; Delacour 1947; Ali 1953; Smythies 1953; Worth 1953; Eaton 1957; Ripley 1961). In Burma and Thailand, according to some authors, the Pied Harrier is the commonest wintering species of the genus *Circus*.

HABITAT

Within the limits of the breeding range mentioned above, the Pied Harrier is confined to flat treeless and usually boggy country. In Ussuriland for instance they haunt meadow land, river valleys, and mossy bogs with thinly growing bushes; in search of food they visit agricultural land and well drained hill slopes covered with grass, thickets of filbert, and dwarf Mongolian oak (Dulkeit 1928; Shulpin 1936; Spangenberg 1940; Vorobiev 1954). In similar habitats these harriers breed in the northern provinces of China. In Assam and N. Burma at the breeding period they also frequent high grass meadows covering wide boggy flood-plains or depressions among hills (Hume 1888; Harington 1903; Baker 1935; Stanford 1935). In the steppes of Transbaikalia and E. Mongolia they keep to places with luxuriant grassy vegetation mainly along river valleys and lake shores, but they were also met far from water (Radde 1863; Taczanowski 1893; Stegmann 1929; Tugarinov 1932; Nasimovich 1949).

In the South of Amurland the Pied Harrier is a very characteristic inseparable component of biocoenosis of flood-plains and hummocky bogs (Stegmann 1930; authoress's observations). In the Svobodnyi District its favoured breeding places are willow and dwarf birch thickets growing in very humid areas. Such boggy thickets grow on the bottom of shallow hollows which serve as a drainage for thawed snow and rainwater (Plate I, *below*). In wide valleys this plant association usually alternates with grasslands and birch groves. The brush cover is formed by dwarf birch (*Betula fruticosa*) and willows (*Salix brachypoda* and *S. myrtilloides*). These plants sometimes spread out on waste territories and form entire impassable thickets, 1-1·5 metres high. The herbage consist mainly of sedges (*Carex schmidtii* and *C. minuta*) forming hummocks up to 30 cm. high. In the monsoon, rainwater between the hummocks favours the growth of mosses (*Sphagnum* and *Aulocomnium palustrae*). Here on the hummocks settles moisture-loving herbage (*Sanguisorba parviflora, Saussurea amurensis, Trollius ledebouri, Angelica maximowiczi, Ligularia sibirica, Iris setosa, I. laevigata, Hemerocallis minor, Caltha palustris*, etc.). Among these plants the globe flowers, irises, and yellow day lilies are especially numerous; with their bright flowers they decorate in summer the monotonous green background of sedges and shrubs. Here and there develop patches of the rough blue joint reed-grass (*Calamagrostis langsdorffii*) and above the trimmed looking thickets rise stunted solitary Asian white birches (*Betula platyphylla*). and Dahurian larches (*Larix dahurica*). At the edge of the forest the variety of the trees increases and includes dwarf Dahurian birches (*Betula dahurica*) and aspens (*Populus tremula*). People and domestic animals visit these thickets rather seldom since they are useless both for haymaking and grazing—a thick layer of dried grass of the previous year prevent growth of fresh grass till the middle of June; moreover, countless hummocks and bushes hinder mowing. Therefore the Pied Harriers find good shelter for their nests well protected from disturbance even when the thickets are close to villages.

Some pairs of Pied Harriers I was able to observe nested on hummocky meadows in the flood-plains of creeks and streams. Numerous mushroom-shaped hummocks (about 50 cm. high) formed by sedges and reed-grasses were surrounded by stagnant water. Herbage was represented mainly by different irises (*I. orientalis, I. setosa, I. laevigata*) and globe flowers (*Trollius ledebouri*). Solitary dwarf birches and willow shrubs or small groups of them were scattered on the flood-plain; some Spiraea shrubs were growing in water filled depressions. After heavy rains the rapid streams inundated these meadows for a short time and carried away all the birds' nests (including the harrier nests) built on the ground or just above the ground level, The nest sites mentioned above were at the same time the principal hunting territories of this harrier. In search of prey the birds visited also dry meadows, cultivated fields, layer field edges, drainage pipes overgrown with vegetation, and open shores of water bodies. Along the valleys they penetrated even into dense forests.

In several years of observation in the Shimanovsk and Svobodnyi districts of Amurland I saw the Pied Harrier willingly occupy nest sites in very narrow (100-150 metres in length) as well as in wide creek valleys stretching for many kilometres. The presence of open plains near the nesting territory was necessary. They avoided the birch willow thickets growing in birch woods or mixed oak and larch forests covering the plateau and its gentle slopes.

The individual range occupied by a single pair of Pied Harrier is usually limited: beside the nesting territory (no more than 2·5 hectares) defended by birds, it includes a hunting territory. The size and outlines of the latter were very variable. Where the nests were built in vast meadows or thickets rich with food the birds hunted near their nests and no farther than 1·5 km. If food was inadequate in territories adjoining the nest site or the nesting territories were separated from the hunting territories by a forest belt, the birds either undertook long distance (up to five km.) flights, or enlarged their search routes by quartering all neighbouring small branches of valleys, clearings, and edges of forests. Pied Harriers are very much attached to their haunts and return every year to the same place notwithstanding deterioration of the habitat. In this connection the observations made upon one pair which nested in 1961 in a marshy thicket near Klimautzy village are of interest. In the following spring a forest fire destroyed in this territory (about 70 or 80 hectares) all the bushes and dried grass. Nevertheless, the Pied Harriers nested at the very edge of the forest on a small dwarf birch thicket (28 × 10 metres) which escaped the fire. Since the fire had devastated their former hunting territory, they were forced to hunt in places they had not visited before.

In 1958-1962 the number of the Pied Harriers in the Svobodnyi district was rather high and one wide creek valley (2·5 km. in radius) held three pairs. The nesting territories of two of them were close to each other, and nearly in all cases their hunting ranges overlapped; nevertheless the relations between birds belonging to different pairs were very peaceful, and I have never seen them fighting over their territories. According to E. Spangenberg (1940), at the lower course of the Iman River (Ussuriland), the distance between separate nests of this bird was no less than one kilometre.

In Amurland in the vicinity of the Pied Harrier nests, and very often in the same habitat, bred the Yellow-breasted Bunting (*Emberiza aureola*), the Lanceolated Warbler (*Locustella lanceolata*), the Siberian Ruddy Crake (*Porzana paykullii*), and the Stonechat (*Saxicola torquata*), and sometimes the Pallas's Grasshopper Warbler (*Locustella certhiola*), the Spotted Bush Warbler (*Tribura taczanowskia*), and Quail (*Coturnix japonica*).

THE SPRING ARRIVAL

Usually the Pied Harrier leaves its winter quarters later than other species of harriers. Single birds have been noted in S. India (Travancore) till the beginning of April (Ferguson & Bourdillon 1904); in Manipur they stay till the middle of April, and some birds, which probably bred somewhere near by, were recorded even at the end of May (Hume 1888). The Pied Harriers left their winter quarters in northern Thailand not earlier than the middle of April (Deignan 1945). In China and S. Yunnan, they remain till April (La Touche 1924); at the same time they were migrating in Kiangsi province (Caldwell 1931); up to 11th April they were recorded in the western part of Kwangsi (Eaton 1957). Northwards, in Hopei, the migration of these birds takes place in April and May (Shaw 1936; Wilder & Hubbard 1938).

At the breeding grounds in the vicinity of Harbin (Manchuria) Pied Harriers were shot at the beginning of May (Meise 1934), and in Korea (Kyonggi Do) the earliest birds were collected at the end of April (Austin 1948). According to G. Duikeit's (1928) observations over several years in the southern parts of Ussuriland (U.S.S.R.) the first solitary males arrive at the end of March or the beginning of April. A marked increase of their numbers was recorded by the same author in April. Some other ornithologists list later dates of spring arrival for that territory, namely 10-29 April and even 4-11 May (Bolau 1881; Dörries 1888; Shulpin 1936; Spangenberg 1940; Omelko 1956).

Unfortunately I got no chance to observe the exact time of the spring arrival in Amurland of the Pied Harriers from their winter quarters. There are in the collection of the Zoological Institute two males which were collected early in spring in this region; one by B. Stegmann on 5th May on Zeya River (60 km. up the river from Blagoveshchensk), and the second one by V. Dorogostaiski on 9th May on the same river near Pikan. No doubt the Pied Harriers arrive a little earlier, since in 1958 when going by train to the study area I saw on 21 and 22 April, males in search of prey flying above vast hummocky bogs between Ushumun and Shimanovsk, as well as in suitable habitats near the towns of Svobodny and Belogorsk. At that time the bogs were still covered with snow here and there. The next day Pied Harriers were rather common in the wide marshes, with numerous isolated lakes, in the flood plain of the lower Zeya River. In 1959 the beginning of May, I regularly met males and females in the southern portion of the Amur-Zeya interfluve. The birds, back from their winter places, leisurely fly (sometimes in the company of Hen Harriers) low over the ground, hunting for prey in the dead grass and bushes. At that time the weather in Amurland is usually cold and windy. Snowfalls and snowstorms happen rather often, and the night temperature is no more than -4° C. Only after 13 or 14 May does the spring influence become more and more evident. Sun thaws the remaining snow, and the soil gradually thaws out eagerly absorbing the water filling depressions among the hills. Though night frosts as a rule takes place till the end of May, on the southern, well-insulated slopes and on the plateau the first plants (sedges, willows, pasqueflower, and rhododendron) begin to blossom. The insects wake up, the numbers of amphibians increase, and rodents become more active, and the Pied Harrier's hunt becomes easier and more productive.

Displays, Courtship

Just after returning from winter quarters the Pied Harriers occupy their territories and stay there during all the breeding period until young birds are able to fly. Only natural calamities such as forest fires and monsoon floods destroying nests and worsening foraging conditions force the harriers to change the boundaries of their range. Similarly, late ploughing and haymaking restrict the hunting territories of Pied Harriers. Pair formation probably takes place in April, but till 10 or 12 May, males and females more often hunt separately, and sometimes at a long distance from each other.

After May 15 the Pied Harriers begin their displays. It is a very peculiar display flight, performed usually by the male but sometimes by the female or by both birds together. At the height of the display period (17-22 May), if the weather is fine and windless, the birds begin their display at sunrise and continue their remarkable evolutions in the air by day. At the beginning the male soars rather high over the nest territory, then suddenly plunges down with closed or partly closed wings and, after a headlong dive, rises nearly vertically with a loud call *ke-ke-kee,* a toneless cackle. As he rises the male somersaults several times. The steep ascent is followed by a new and sudden spectacular dive, and then an easy rise with breathtaking aerobatics, accompanied always by the characteristic display note. After each dive the harrier gradually loses height. Approaching the ground he rolls one or more times on his long axis, not only at ascents but at descents also. The black and white bird displaying early in the morning is a delectable sight against a background of bright blue cloudless sky. At the beginning of the breeding season several males belonging to pairs living side by side display simultaneously before one female as if competing in adroitness. The female during her evolutions in the air also rolls and somersaults. Being pursued by the cock she usually stops her aerobatics, turns momentarily on the back to ward off the male. The call uttered by the female in this flight is a similar nasal cheep. When the male is displaying alone he, from time to time sinks into the tall growth of the previous year's grass, near his sitting mate or in the vicinity. Sometimes he takes to wing with a small twig in his beak; and transferring it to his claws starts to glide over his mate resting on the ground. The twig being dropped the male sinks to the grass and calls the female, who answers his low *cluck* with a shrill whistle. After a short interval the male again gains height and repeats his display manoeuvres, and so on.

Such displays continue during nest-building and even when the first egg is laid, though the male alone is busy with his aerobatics. The last displaying males were recorded by me on the Amur-Zeya plateau on 25 May 1961 and 28 May 1962.

On May 20, in the vicinity of Klimautzy village I happened to observe the first copulating Pied Harriers. Soon after a display flight, the male landed at the nest site (70-80 metres from the clearing where the harriers two days later began to build their nest) and his mate approached him. She drove away the male and occupying his place on the top of the hummock delivered a drawling whistle, ruffled her plumage, and shook her wings; at the same time she attentively watched her partner circling over her. After some circles were made the male suddenly stopped his flight and raising his wings high up alighted on the hen's back. Immediately after completing copulation he flew away, leaving her alone for some time on the ground. Subsequent coitions took place at the nest.

About a week before the nesting period the females nearly stop hunting. From the end of May onward they live solely on the food provided by males and Pied Harrier hens flying in search of food over the dwarf birch and willow thickets are very seldom to be seen. More often the female sat with ruffled feathers on a hummock, a low stub, or a low branch of the squat larch or of a dead fallen tree somewhere in the creek valley in the vicinity of her future nest. The moment the female saw the male she swiftly flew out to meet him, and begged for food. If the male was returning without prey, or if he ate it surreptitiously the female passed from begging for food to an active attack. She struck him on the wings with her beak and feet, and pursued him with a shrill whistle till he left the territory. If the female did not notice the male immediately on his return, he descended into the thickets and uttered a very peculiar bi-syllabled quacking chatter. As a rule this gave no results, and he then flew up with the prey in his talons where she could see him. If the female was flying below the male she took the food from him from below with striking dexterity and swiftness. In several cases the prey was passed in mid air from foot to foot or from the male to his mate on the ground.

Both mates spent the night on hummocks among grass and shrubs, separately, and at several metres from each other. The roosting place of the male was more or less constant throughout the summer season. From the beginning of egg laying the female passed her nights in the nest. On frosty May nights it was always particularly cold in damp hollows; and after sun rise the area remained for a long time in the shadow of hills and surrounding forest. This is probably why the Pied Harriers rose from the ground early in the morning and perched on the tops of sun-lit trees at the very edge of the valley. At first the birds basked motionless in the sun, then began preening. Soon the male flew away to hunt while the female continued basking till it becomes warmer and grass and thickets become dry on the surface.

It is of interest that, contrary to other harriers, the Pied Harriers readily perched on trees—males occupied in general high bare-topped pines and larches, females preferred small trees.

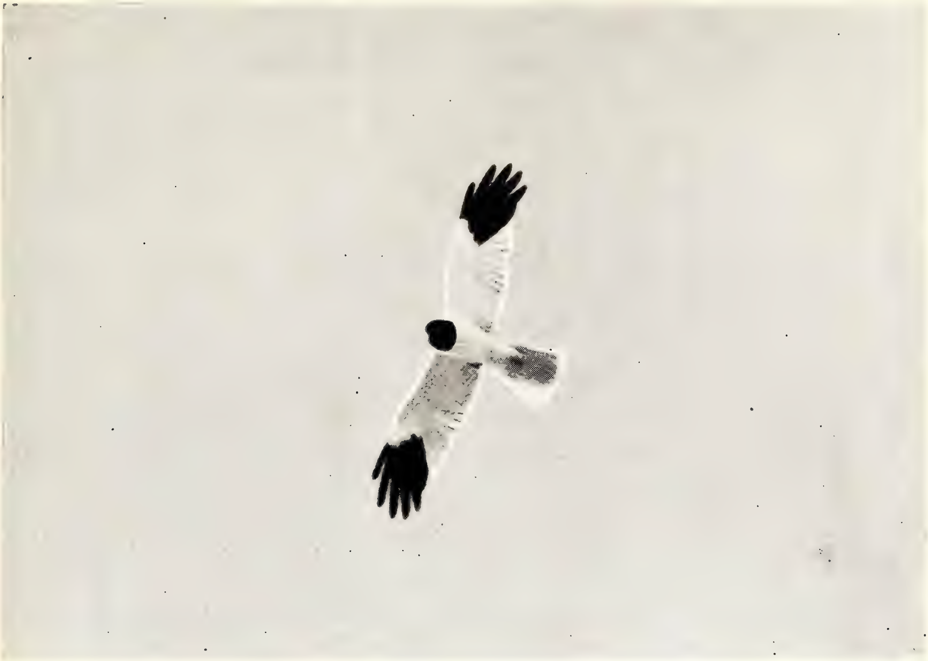
BREEDING

The nest and nest building:

The male played a dominant role in selecting a place for the nest and in the collection of materials. Some days before nest building began he could be seen flying with twigs or blades of grass in his claws, and haphazardly leaving the material on the hummocks. Meanwhile the female flew near by showing little interest. In Amurland the majority of the Pied Harriers started nest building 21st-23rd May, and some solitary pairs 7-10 days later.

In all cases known to me nests were built on hummocks covered with dry sedge and were well disguised among thick grass and shrubs

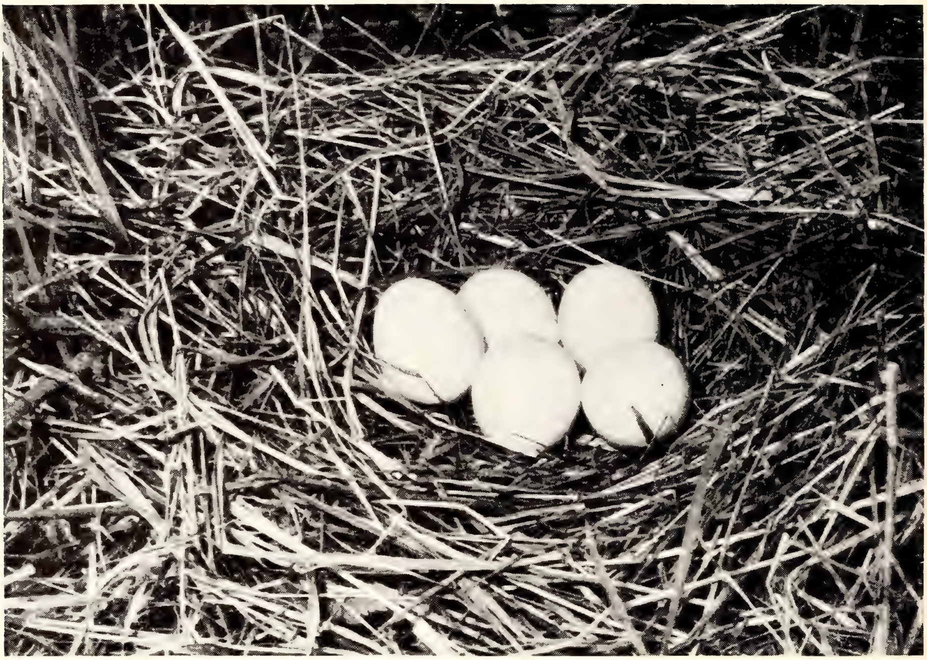
Neufeldt : Pied Harrier

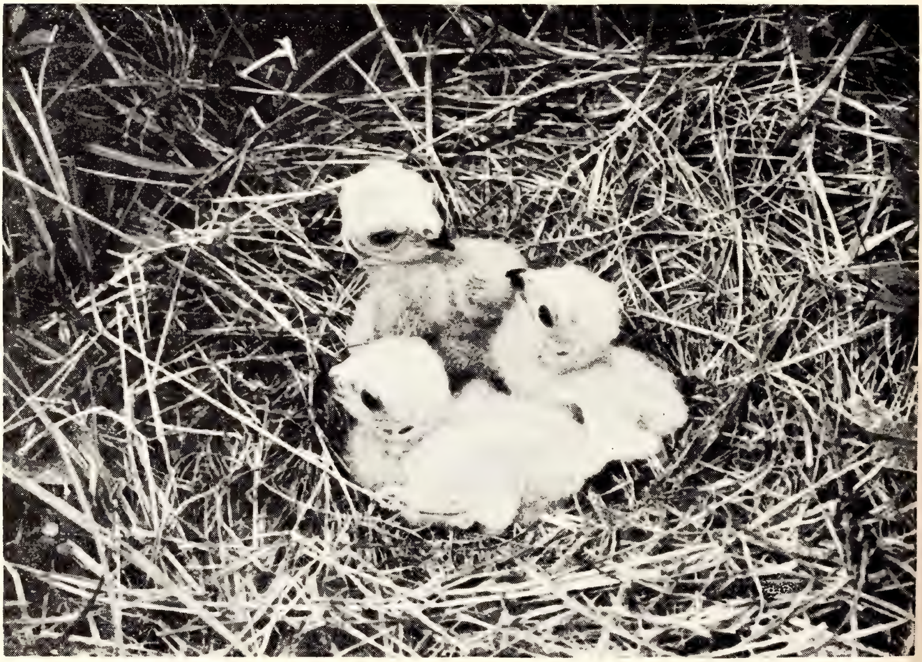


Above : Pied Harrier male in flight ; *Below :* Habitat of Pied Harrier in Amurland, May 1958.

(*Photos : I. Neufeldt*)

Neufeldt : Pied Harrier





Above : Nest and eggs of Pied Harrier ; *Below :* Pied Harrier chicks in first down.

(*Photos : I. Neufeldt*)

(Plate II, *above*). Flooded meadows, where during heavy summer rains the nests were easily destroyed by water, were usually avoided; the birds settled there rather unwillingly and chose the highest hummocks. On the contrary in the valleys even small hummocks were not flooded by rain-water and served for this reason as a rather reliable ground for the primitive constructions of these birds.

Building materials were usually collected near by. The male was repeatedly observed by us walking about in the previous year's grass or near old haystacks and picking up straws and thin twigs. When flying up a male usually shifts its burden from the beak to the feet and only then brings it to the nest. The hen was usually waiting below among shrubs of dwarf birches. She arranged the material and did practically all the building work, but did not carry building material. Each appearance of the male was met by her with a loud shrill whistle (similar to the 'food-call'). The male either dropped twigs and blades of grass in the nest or raising his wings above the back settled in the thickets and himself arranged the material. Small larch or birch twigs were used for the bottom and outer borders of the nest; straw of wild cereals e.g., *Calamagrostis langsdorffii*—for the walls; fine leaves of sedge and soft parts of other plants for lining the cup. Usually nest building took from 3 to 4 days.

When ready the nest is a thin (not more than 30 mm.) and at first rather loose in construction. The measurements of eight newly-built nests in Amurland were as follows: external diameter 230-270 mm., internal diameter 140-160 mm. and depth of the nest cup 45-60 mm.

Later, during incubation and when there are nestlings in the nest the walls gradually thicken reaching sometimes 120-130 and even 150 mm. The fact is that during the whole breeding period the hen (very seldom the cock) renews the construction. No case is known when the frightened female returned back to the nest without bringing a bunch of dry grass or twigs.[1] This behaviour can hardly be attributed to her wanting to keep the nest clean because she begins to add material in the nest long before hatching. I think that the building up of the nest aims at protecting the eggs and then the nestlings against the moisture soaking into the nest from below from the ground during rainy season. Apparently such superstructured, more solid nests were erroneously taken by G. Dulkeit (1928) for old ones, used in previous years. Later his opinion found its way into a number of ornithological reviews (Dementiev 1951; Portenko 1951). In fact, every year the Pied Harriers return to their former breeding place and build a new nest in the vicinity or at a rather long distance from the old one.

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[1] The exceptions are flights with food for chicks,

When the nest is built the hen often sits in it though egg-laying starts only 4-5 days later. Now she rarely leaves her nesting area keeping close to the region of the nest, and gives her alarm-call while chasing crows, kites, and other large birds which encroach upon her territory, and shows alarm at the appearance of man.

Breeding season:

In the different parts of their rather limited and separated breeding range, Pied Harriers start breeding at different times. In north-eastern India and in the north of Burma nests containing one egg were found on 13-20 April (Hume 1888; Stanford 1935). A month later the first eggs were laid in Manchuria and Ussuriland (Dulkeit 1928; Yamashina 1939; Spangenberg 1940). Near the northern border of their range (Amur-Zeya Plateau) the laying began only at the end of May. Thus, in the nests found in 1961 and 1962 in the vicinity of Klimautzy village the first fresh eggs were recorded on

Table

Egg measurements

Serial No. of nest	Egg number	Absolute size (in mm.)		Average size of eggs from one clutch (in mm.)
		Length	Breadth	
1	I	42·5	35·0	42·4×35·0
	II	42·0	35·0	
	III	42·0	35·0	
	IV	43·0	35·0	
2	I	44·0	36·0	44·9×35·9
	II	44·5	35·0	
	III	45·0	35·0	
	IV	45·0	36·5	
	V	46·0	37·0	
3	I	45·0	34·5	45·5×35·7
	II	45·0	36·5	
	III	46·0	35·0	
	IV	46·1	36·8	
4	I	47·6	35·0	48·8×35·7
	II	49·0	36·3	
	III	49·3	35·3	
	IV	49·4	36·0	
5	I	43·0	35·0	43·7×34·8
	II	43·0	35·0	
	III	43·4	34·0	
	IV	45·7	35·0	
6	I	42·5	38·0	44·3×37·2
	II	43·0	37·0	
	III	44·0	37·0	
	IV	46·0	36·0	
	V	46·0	38·0	

26, 28, 29 May and on 1, 2, 8 June. In the first half of June over the investigated territory nests had full clutches and only a few individuals were laying as late as the middle of the month.

Clutch size, eggs:

Eggs were usually laid in the morning, as a rule at intervals of 48 hours. Once a hen laid the last (her third) egg, three days after the second. The normal full clutch of the Pied Harrier consists of 4 to 5 eggs. 50% of nests found in Amurland contained 4 eggs, the others 5 eggs (Plate II, *above*). All clutches found in southern Ussuriland, described by G. Dulkeit and E. Spangenberg, consisted of 5 eggs. For Transbaikalia nests are known with 4 and even 3 eggs (Taczanowski 1893); the latter are supposed to be incomplete.

The eggs are roundish. Only in one of the nests (No. 4 in the Table) the eggs happened to be somewhat elongated, and their length exceeding their width by 13 mm. In other instances this difference was less (7·0-9·0 mm.). The table presents the main measurements of eggs from 6 nests examined near Klimautzy village. As one may see from this table the size of eggs varies insignificantly not only within one clutch but also between nests belonging to different individuals.

No difference was seen on comparison of these measurements with those from Transbaikalia, Ussuriland and Manchuria.

The egg is usually pure white, occasionally bluish-white, without gloss. As the female's feet were constantly stained with blood from its prey, after several days of incubation the eggs had definite red-brown streaks and spots; these are erroneously taken by some ornithologists for natural pigmentation of the egg-shell.

Incubation:

During the breeding period the duties of the parents were sharply differentiated. I never saw the male brooding the eggs. L. Shulpin (1936) writes that he never found brood patches in Pied Harrier cocks. These were not found in specimens from the collection of Zoological Institute of the Academy of Sciences as well as in males shot in Amurland in 1957 and 1959. Eggs are incubated by the hen only, and this is not an exception among the harriers. However males have been twice reported as flushed from nests containing eggs, with females alive (Dulkeit 1928; Spangenberg 1940). Though in both cases the reason of male's stay in the nest was not clarified, these observations led to other authors writing of the participation of the male in incubation. It seems more probable that the male was flushed from the nest, when he delayed there after feeding his mate or after laying in the nest additional building material.

The incubation begins with the first egg. During the first two days a female does not stay in the nest all the time. In the morning she flies out to warm herself for a while in the sun, and during the day when she feels very hungry. With each addition to the clutch she sits more closely. The full clutch is usually left by the hen, only for accepting food. Within the period of egg-incubation the behaviour of females differed a great deal. Some took wing on the appearance of a man at 5-6 m. distance from the nest, but the majority allowed a very close approach and flew out calling almost from one's leg. Such difference in their behaviour depends apparently not only on the individual peculiarities of temperament but also on the radius of the field of vision, which is different in birds sitting in the dwarfish sparse thickets or in the thick impassable shrubs of dwarf birches and high grass. In contrast to dendrophylous birds of prey, which from their nests high above the ground easily notice a stranger intruding into their territory, harriers living in grass and shrubs may see an enemy only at a short distance from the nest[1]. The Pied Harrier hen sitting on eggs (or chicks) is always alert to noises in the vicinity. At the slightest rustle she raises the feathers of the facial disc and turns the head in the direction of the source of sound (Plate III, *below*). Under the peculiar ecological condition of nesting the wonderfully developed acoustic sensitivity of this bird fixes the direction of approaching danger earlier than the eye does. However, only on seeing the enemy does the female fly up.

Within the whole breeding period the male's duty consists mainly of feeding his mate and then the chicks. Having returned after the hunt with prey in the talons the male usually calls his mate out of the nest and passes food to her in flight. Sometimes the transmission of food takes place in the nest; nevertheless the hen always eats the prey somewhere away from but in the immediate vicinity of the nest. If the male is not occupied in hunting he perches in a tree or on a stump not far from the nest. He notices an approaching man right away, raises an alarm, and flies out to meet the enemy. In this moment the female gets alert and flies from the nest to join the male and they begin circling above the intruder uttering characteristic alarm notes. At the end of incubation when chicks have hatched both parents defend their nest more actively and may become brave enough to dive at a great speed trying to strike the intruder's head.

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[1] This refers to birds in the nest only.

E. Spangenberg (1940) reports that in case the female dies the male is capable of taking her place on the eggs.

It is known that the period of incubation depends on the duration of the embryonal development of the nestlings. For Pied Harriers (on the Amur-Zeya Plateau) the duration of incubation was observed to vary under natural conditions. Even in the same nest it varies from 30 to 32 days for each egg. In the first egg the embryo takes one or sometimes two days longer than in other eggs, apparently due to irregular brooding by hen during the first days of incubation. The period from the laying of the first egg till the hatching of the last nestling lasts (depending on the size of the clutch) 37-39 days.

In the majority of nests examined the hatching of chicks took place in the first ten days of July and only in delayed clutches lasted up to the end of the month. The hatching process of the nestling takes on an average about a day. In one instance it took more than two days. The number of unfertilized eggs is small. Out of 31 eggs only one (in the clutch with 5 eggs) was addled.

The nestlings' growth:

Newly hatched chick is covered with short but rather thick (except on the belly) down (Plate II, *below*) which on the greater part of the body is of a pale colour; on the forehead, nape, chin, external edge of the wing, tibia, and abdomen it is white. There is a stripe formed by very short darker down, passing from the bill through the lores to the eye, and a brownish-black down ring around the eye. The eyes of the newly-hatched chick are half-open; upper mandible, the top of the lower mandible and the skin of the edges of eyelids black; the cere, mouth wrinkles, and the base of the lower mandible yellowish-pink; the skin of the body pink; legs and claws of wax colour. The male nestlings at this age weighed 18-18·7 gm. the females 22·6-22·8 gm. Since the hen incubates from the first egg the young hatch out at different times. At the hatching of the last chick the first one is already 3-5 days old. For individuals belonging to one and the same sex this means a difference of 23-25 gm. On the fourth day the young Pied Harriers can move about the nest, leaning upon the tarsus and balancing with their wings. They are capable also of crawling away, into dense grass and thickets. On the first day of hatching the excrement of the chicks remains in the nest or is eaten by the hen, later the nestlings before each defecation move backwards to the edge of the nest and defecate a great distance away from its edge. The 6-day old chick develops the feather-tubes of the future remiges and their coverts which, as well as rectrices, force out the first down; the sheaths of the second down begin to unfold.

The second down plumage develops on the pterylae and apteria of the previous juvenile plumage. In the first instance a part of second down grows in addition to the previous (first down) plumage. In the second instance the whole down plumage is of primary origin. When the nestling is about two weeks old the growth of the secondary down plumage is completed. New down evenly covers the body of the nestling. Only some parts along the neck, on the lower throat, under wings, and on the abdomen remain bare. The second down differs from the first in having more of barbs and barbules. The colour is darker, ochre or pale-ochre. Only on the nape, on both sides of the head, and on the forehead the down is white. On the 14th-15th day young males weigh 140-142 gm., i.e. reach nearly half the weight of adult individuals of the same sex. The weight of adult birds shot in Amurland: ♂♂—283·4 and 302 gm., ♀—600 gm. The movements of two-week old nestlings are rather uncertain but they already lean upon the toes. The hen broods its growing young since they need warmth, especially at night and in rainy weather. When it is hot chicks often leave the nest, which is not protected from the sun's rays, and hide themselves in the shade of grass and thickets. On hearing the female's feeding call they return to the nest. On the approach of the observer the chicks move backwards in fright and then strike a defensive attitude, characteristic of all young diurnal predators: lying on their back, feet with sharp claws up.

17-18-day-old nestlings stand firmly on their feet and in case of danger try to hide themselves in dense thickets. Little by little they tread out visible paths between hummocks on which they may quickly and without difficulty move for some metres from the nest. Sometimes 19-20-day-old birds leave their nests and settle in another place. The female (and sometimes the male) thereupon brings twigs and straws and soon in the crushed sedge there appears a new nest similar to the old. The young remain in or near this nest for about one month. In the second half of August, the 35-45-days-young take to the wing, but are not fully fledged.

Though a normal clutch of Pied Harrier consists of 4-5 eggs, the brood usually has no more than 3 young. The mortality of chicks especially in the early stages of post-embryonal development is very high. Out of 30 chicks from nests known to me only 20 (67%) lived as long as two weeks. First of all dies the youngest (the fourth or fifth) nestling in the brood. It hatches 3-5 days later than the others, and is very weak. Being jostled away by its older brothers during feeding it seldom receives its share of food. With age its weight does not increase, on the contrary, it decreases. On the 3rd-4th day such chicks cease asking for food and lie nearly motionless in the nest and soon die. Grown up 7-12-days-old chicks, which are in the habit of leaving the nest, sometimes become so wet in rainy season that they perish from cold due to the imperfection of their heat regulating abilities. Sometimes, dispersed in different directions, young birds become an easy prey of predatory mammals. In July of 1962 one brood was entirely destroyed by forest fire which spread to the territory occupied by the Pied Harriers.

When in the nest the young birds can be infested by different arthropods: ticks, mosquitoes, black flies, etc. The main injury is done by parasitic larvae of flies of the genus *Protocalliphora*, which penetrate external ear openings and acoustic ducts, nasal ducts, quills of growing feathers or simply settle on parts of the body stained with blood by the hen's feet. A very strong infestation by these larvae blocks nostrils of chicks; breaking through the ear-drum they penetrate the middle ear and sometimes injure large feathers to such an extent that some of them break off.

Behaviour of the parents:

With young in the nest the duties of the parents are again strictly differentiated. The male provides food for the family, the female broods and feeds the chicks. But as was observed in 1961 when the hen was shot after hatching all the nestlings, its mate successfully fulfilled all her duties.

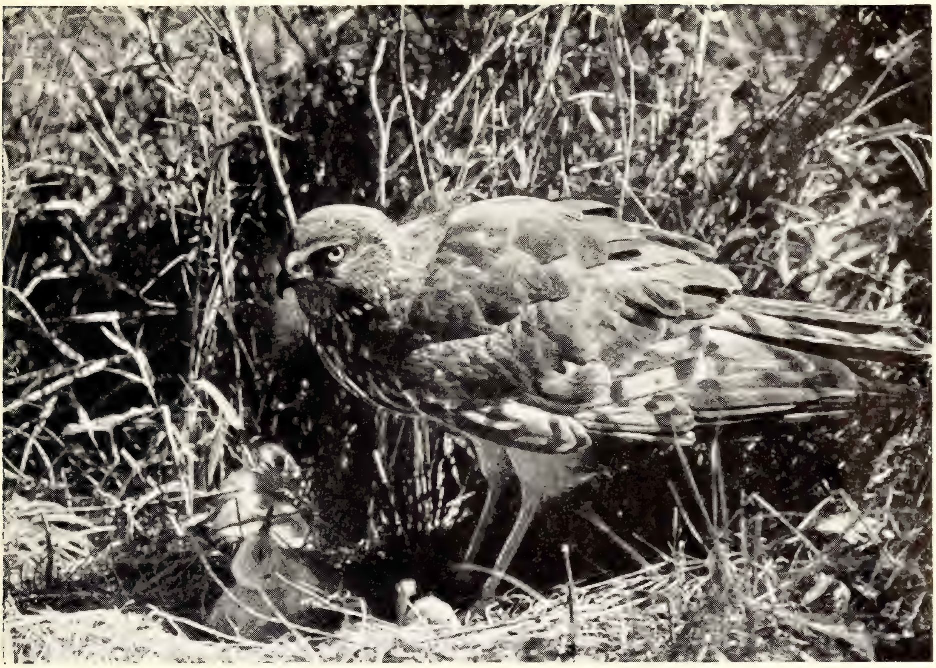
Pied Harriers are born coldblooded (poikilothermal). Within the first two weeks until thermoregulation of the nestlings is established the female seldom leaves the nest (Plate III. *below*). She broods the chicks almost constantly raising herself sometimes to get annoying insects from the nest bottom or to take out carefully larvae of *Protocalliphora* from the ear openings of small nestlings. During the hot hours of the day the hen stands with extended wings above the nestlings protecting them from the direct sun rays (Plate III *above*). Before leaving the nest the adult bird slowly raises herself a little, ruffles her feathers on the belly, carefully tucks up and puts her wings together making herself clear of the chicks or eggs. On rapid and sudden upward flight the female sometimes throws about the contents of the nest. On returning she puts back in their place only immovable objects, i.e. eggs or newly hatched nestlings. In my field journal there is the following record: 'July 7, 1961. With an imprudent gesture I frightened away a female which brooded four chicks and one egg with punctured (cracked) shell. When flighting the hen scattered two young and the egg some 30-40 cm. distance from the nest-cup and the egg broke. Soon the female returned and started brooding the nestlings left in the nest. Without paying attention to the other chicks she examined intently the newly-born nestling and debris of the egg-shell. Then she suddenly raised herself, took the shell by the beak and put it accurately in the nest between the chicks. In some seconds she raised again, took out from under herself the egg-shell which apparently was mistaken by her for the egg and began to eat the blood stained shell membranes. Then leaving the shell the bird again started looking at the white ball lying down motionlessly near by, came to it, and carried back in her beak the newly-hatched chick to the nest. The older nestlings got to the nest as soon as they heard the feeding call of the female.'

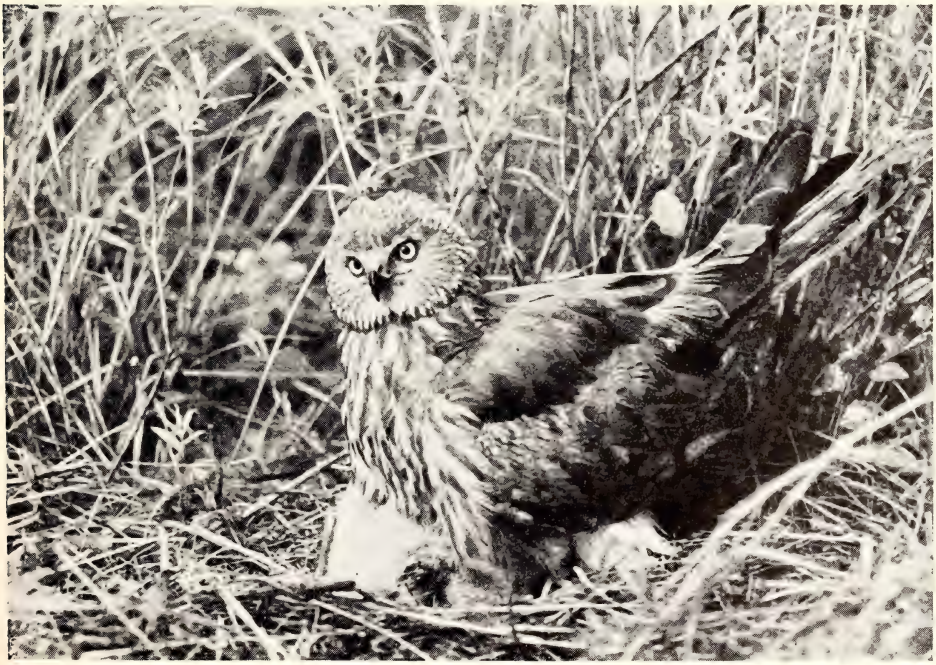
While the nestlings are very small the female spends nearly all her time in the nest and is fed by her mate as well as during egg-incubation. The cock usually flies several times above the nest calling his mate. The hen answers with a plaintive, thin, whistling note and rises into the air. When flying alongside the male the female sharply brakes and with quick side movement of the foot catches the food and returns to the nest. During the hatching period or in rainy weather sometimes the male with prey clutched in his talons flies lower and lower and drops it in the nest. Systematic observation upon two families of Pied Harriers has shown that within first 10-12 days of the nestling's life the male never visits the nest. 19-20-days-old young are brooded by the female only at night or in rainy weather and during a sudden fall in the temperature. Thereafter the chicks remain alone in the nest for longer and longer periods, the female and her mate being engaged in hunting. When the hen is absent the male feeds young by tearing the food to bits.

MOULT

Adult Pied Harriers have one complete moult in a year. Soon after incubation begins the old worn out feathers of the females start to fall and are replaced by new ones; the moult of the males, who provide food for the family, occurs when the young are airborne. In Amurland on June 6-9 there were birds that had lost the 10th and 9th primaries. By 15th-16th of June these feathers were half grown and the next ones (8th and 7th) fell out. At the same time the corresponding coverts and small plumage of the breast, sides and back moulted. The female shot in Transbaikalia on June 13 (preserved in

Neufeldt : Pied Harrier

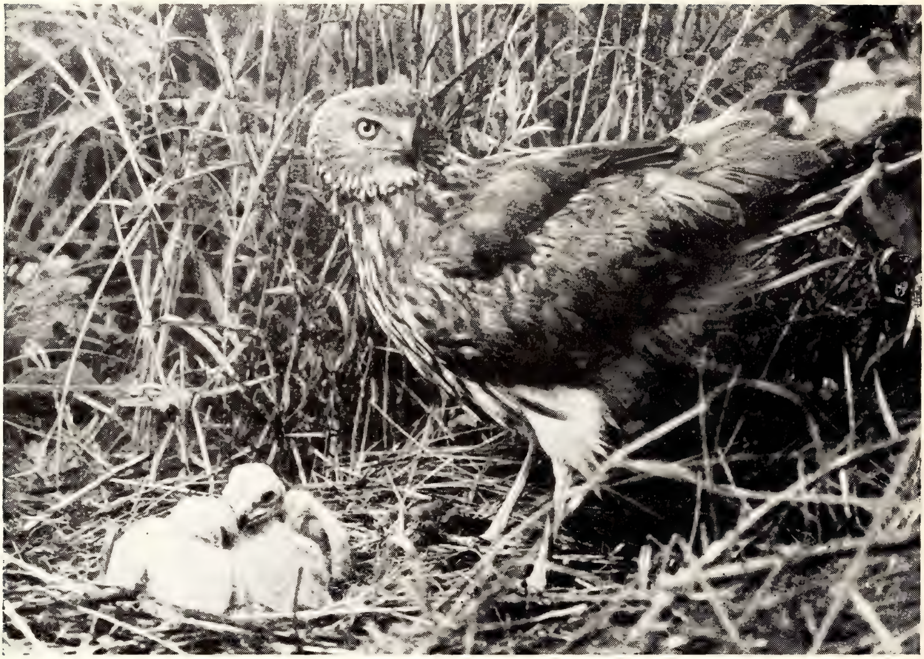


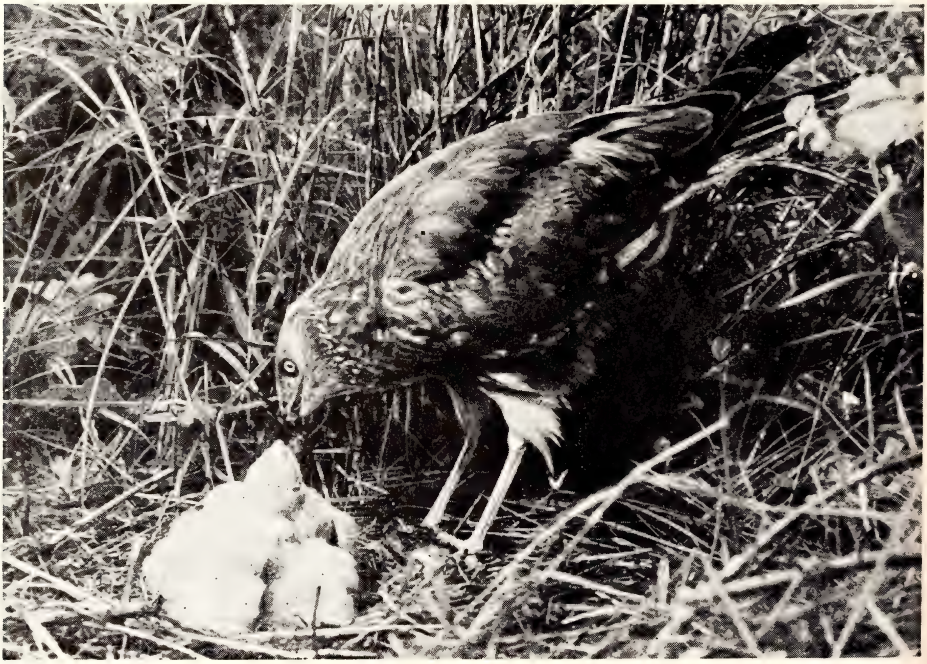


Above : Pied Harrier (female) protecting nestlings from the direct rays of the sun ; *Below :* Pied Harrier female brooding partly grown young.

(*Photos : I. Neufeldt*)

Neufeldt : Pied Harrier





Above and *Below :* Pied Harrier female feeding young.

(*Photos : I. Neufeldt*)

collection of the Zoological Institute of the Academy of Sciences) is approximately in the same state of moult; 10th and 9th primaries in sheaths, 8th absent. On June 21-26 in the majority of individuals from Amurland the 10th primary flight feathers had reached normal length, and the 9th and 8th were $\frac{4}{5}$ of normal length. On June 28 in one female the 10th primaries had moulted, the 9th were $\frac{4}{5}$ and 8th and 7th $\frac{2}{3}$ of normal length. In southern Ussuriland the moult takes place at the same time. Thus in the female shot on 15th June the 10th and 9th primaries were $\frac{2}{3}$, and the 8th $\frac{1}{2}$ of normal length, and the central rectrices had begun to unfold; in another female shot on June 27 the new 10th, 9th, and 8th primaries had reached normal length, the 7th were still in sheaths (Materials of Zool. Inst. Acad. Sci., U.S.S.R.). In the specimens from Upper Amurland in the first days of July, i.e. by the time of chicks hatching, the female's 10-8th primaries and their coverts had finished their growth. Some individuals exceptionally begin moulting only in July. All adult females shot on September 8-16 in Manchuria were (according to Meise 1934) in the moulting state. H. Deignan (1945) on 27th December found in birds wintering in northern Thailand central rectrices, which had not reached the normal length.

Male Pied Harriers start moulting later than the females and not so simultaneously. In the collection of the Zoological Institute in Leningrad there are the following moulting specimens: June 18—the 10th primaries $\frac{1}{2}$ of normal length, 9th appearing from the sheaths, one central rectrix half grown; on June 19—10th primaries in horny sheaths, 9th remiges and one middle tail feather absent; on June 28—10th primaries of normal length, 9th $\frac{3}{4}$ of normal length. On the 27-28 June in the region of the Upper Amur the majority of the males had lost the 8th and even the 7th primaries though specimens occurred without any signs of moult. To the number of late-moulting birds may be referred a male taken on July 25 from the nest with grown-up chicks: his 10th primaries hardly reached $\frac{4}{5}$ and one central rectrix $\frac{1}{2}$ of normal length. It should be noted that in females the change of tail feathers usually started when some remiges had already moulted; males lost the central rectrices nearly at the same time with the last (10th), sometimes the last but one (9th) primaries. Before leaving the breeding range males, as a rule, have time to change not less than 6 primaries, half the rectrices, and the majority of the small feathers on the head, neck, lower throat, back and belly (a specimen from Ussuriland housed in Zool. Inst. Acad. Sc., U.S.S.R.). Beginning with the nest building the moult continues during migration and is completed in the winter-quarters. The shortage of material at my disposal does not enable me to describe the whole process of the Pied Harrier's moult.

AUTUMN MIGRATION

There are rather scanty data in the literature concerning the time of autumn migration of Pied Harriers. Thus, they were observed to migrate gradually from Ussuriland from the end of September till the middle of October; only solitary birds stayed as long as November 13 (Dulkeit 1928; Shulpin 1936; Vorobiev 1954; Belopolsky 1955). In autumn the birds sometimes stray beyond the limits of the range. Thus according to A. Gizenko (1955), one female was shot on October 24, 1946 on Sakhalin (near the town of Novo-Aleksandrovsk). In the middle of September Pied Harriers occur rather often in Manchuria and Korea (Ingram 1909; Kuroda 1931; Yamashina 1932; Meise 1934; Austin 1948). In China, in Hopei province, groups or solitary birds migrate southwards from the end of August till the end of October, sometimes till November 9 (La Touche 1932; Shaw 1936; Wilder & Hubbard 1938). The migration routes cross China and sometimes Mongolia. G. Dementiev (1962) recorded the Pied Harrier on passage in autumn of 1958-1960 in Mongolian Gobi Desert. In Burma the earliest appeared on September 6, the latest in November (Bingham 1880; Smythies 1953). In western Kwangsi (China) they were recorded from October 30 (Eaton 1957) and in northern Thailand from October 4 (Deignan 1945).

FOOD, HUNTING, AND FEEDING OF YOUNG

The analysis of the contents of stomachs and pellets as well as direct observations upon hunting and feeding Pied Harriers have shown that the major part of their diet in the south of the Amur-Zeya plateau was constituted by rodents (85%)[1]. The most common were Ungur Voles (*Microtus ungurensis*) inhabiting hummocky boggy swales and willow and dwarf birch thickets. Siberian and Redbacked Voles (*Clethrionomys rutilus*) confined to well drained parts of forests, fields, and gardens make only 23% of their diet. Other species of rodents (*Apodemus agrarius*, *Micromys minutus*, *Clethrionomys rufocanus*, and *Eutamias sibiricus*) were equally represented in the food ration of these diurnal predators (5-3%). Eighteen per cent of the prey of Pied Harriers was formed of the remains of small passerine birds. In May, adult Yellow-breasted Buntings (*Emberiza aureola*) sometimes became the prey of these harriers; at the end of

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[1] The bone remains of the mammals were kindly identified by M. Erbaeva.

June, and in July they took exclusively the young of these buntings and sometimes fledglings of Indian Tree Pipits (*Anthus hodgsoni*). In spring and sometimes in summer they hunted for frogs (*Rana chensinensis*) 5·8%. As a very rare food which is of little importance the Common Shrew (*Sorex* sp.) and insects (Grasshoppers, bugs, large nocturnal moths and beetles) may be mentioned.

Pied Harriers hunt in poor light, most actively in the morning and in the evening. I repeatedly saw males on warm May evenings in clear windless weather, when it was almost dark, inspecting bogs swarming with frogs. In searching for food under such conditions their keen sense of hearing is apparently of no small importance. They fly very low over the ground (at 1·5-1·0 m.) systematically quartering the ground, following the roughness of the terrain and manoeuvring among the trees and bushes. Very thoroughly they inspect the neighbouring willow and dwarf birch thickets, damp meadows, and old sod fields. At the end of summer they like to visit the parts of the fields bordering the forest on which they catch in general Large-toothed Redbacked Voles and young Chipmunks. They search for food in gardens and pastures situated along the outskirts of settlements. The flight is graceful and buoyant with several wing beats and then a glide. They take the prey from the ground, grass and even from water. The way of catching mammals, fledgling of ground-nesting birds, amphibians, and insects is the same in general. On discovering the prey the Pied Harrier stops for a moment as if hanging poised in mid air and then with widely stretched wings and long legs showing sinks quickly down into dense grass or shrubs. At this moment the Harrier usually has time to snatch its prey. If it misses its mark the bird sometimes lands under its own momentum, but more often it easily picks up altitude and continues its hunting flight. Sometimes Pied Harriers resort to other (less advantageous) means of hunting, for instance they search for small animals walking on the ground in the standing crop which due to the insignificant thickness is easily seen through, or wait for them perching on any small eminence (lump of soil, stone, etc.). When it sees the prey the harrier impetuously attacks it trying to take it unawares, or pursues it with agility on the ground. Sometimes Pied Harriers try to seize small birds on the wing; such hunting is seldom successful. Ball-like nests of the Harvest Mouse, which are so numerous on the thickets or in dense grass in open valleys, are plucked by the harrier in flight. Then with the mouse-nest in its claws it comes down, tears the nest open with its bill and gets the helpless young mice.

As mentioned earlier, beginning with the breeding period, for two months the female practically does not hunt. All the food is provided by the male and the hen remains at nest till called off. On capturing the prey the male immediately kills it in its taloned feet. He is nearly always hungry, that is why the male dresses the food, ripping the head of the prey and swallowing it as well as the greater part of the skin. The body of the animal the cock passes to his mate in flight. The kind of food given to the young corresponds in general to the summer diet of parents themselves. The difference is that the female gives to the nestlings the most soft and delicious pieces of the meat and only on 10th-12th day begins to feed them with the bones, viscera, and skin of rodents, birds and frogs. Such nestlings begin to eject pellets. The frequency of feeding the nestlings depends first of all on the success of the male's hunting. In favourable weather the male brings food approximately each 45-50 minutes, carrying not more than one animal. By day in hot weather intermissions may be longer: one and a half to two hours. The female brings food in her talons and feeds it in torn bits to small nestlings (Plate IV). She contents herself with the remains of the food—the viscera and the half-cleaned skeleton. When the chicks are older they tear up the prey themselves. When on the wing the young harriers continue to beg for food. Now they are fed by parents by dropping prey in the air (the way that was described above for the brooding female).

According to the data of H. Bolau (1881), F. Dörries (1888), G. Dulkeit (1928), L. Shulpin (1936), E. Spangenberg (1940), and K. Vorobiev (1954) in the stomachs of Pied Harriers shot in Ussuriland rodents were found in general; shrews, passerines, frogs and insects were represented by solitary specimens. In the U.S.S.R. the species in question is an obligate miophag. It destroys a great number of pests of agricultural crops and vectors of dangerous transmittable diseases of man and domestic animals. As such it is of great benefit and deserves protection.

As to the food of Pied Harriers in the other parts of its range the literature dealing with the question is very scanty. It is known, for instance, that rodents are their main food in north-eastern provinces of China and reptiles, frogs, small birds, and insects are of secondary significance (La Touche 1932: Shaw 1936; Wilder & Hubbard 1938). In India, Pied Harriers, apart from mice, feed sometimes upon insects, sometimes upon frogs and snakes (Cripps 1882; Hume 1888; Baker 1928). When breeding and wintering in Burma they get, in general, frogs and large insects; it happens sometimes that they attack birds and catch crabs (Oates 1883; Stanford 1935). Frogs are the main prey of Pied Harriers wintering in northern Thailand. The lizards, small snakes and birds were represented in the stomachs by solitary specimens (Deignan 1945).

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The nesting activities of the vespoid potter wasp *Eumenes campaniformis esuriens* (Fabr.) compared with the ecologically similar sphecoid *Sceliphron madraspatanum* (Fabr.) (Hymenoptera)

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(*With eight figures*)

INTRODUCTION

Bhubaneswar (20° 15′ N., 85° 50′ E., height 45 m.) is in part an administrative capital built since 1948 on recently cleared thinly covered lateritic rock. The mean monthly rainfalls in mm. beginning with January are: 14·5, 23·6, 16·0, 23·4, 67·3, 216·7, 336·8, 320·0, 248·8, 158·0, 53·3, and 4·8.

Since arriving here, we have kept records of wasps. This paper describes the observations made on the commonest species of vespoid potter. According to Bingham (1897) this species is *Eumenes esuriens* Fabr. We learn from Iwata (1964) that this form is now considered to be *E. campaniformis esuriens* (Fabr.). We have large series collected during the course of this work, some of which have already been sent to a taxonomist.

In its habits *esuriens* shows much convergence with the sphecoid potter *Sceliphron madraspatanum* (Fabr.) with which we have worked in Calcutta (22° 34′ N., 88° 24′ E., sea-level). We therefore consider for comparison both our previous observations on the latter species and those we have made at Bhubaneswar, designating as *m*1 the Calcutta animal previously described (Spurway, Dronamraju & Jayakar 1964). We (Jayakar *et al.* 1964) have also published a note on an individual *esuriens* here called *e*10.

MATERIALS AND LOCATION

Table 1 lists all wasps of these species seen associated with nests between 23-8-62 and 9-10-64. All nests were built on human artifacts and all were sheltered by roofs.

TABLE I

LOCALITY DATA OF NESTS

Wasp	Height above ground level (cm.)	No. of surfaces built on			When found	Stage	When left	Stage	Temperature C.	
		wood	masonry	others					max.	min.
e 1 o	61		2		1-9-62	sealing cell I	3-9-62	cell IV begun	32·8	25·6
e 2 o	61		2		3-10-62	selecting site	8-10-62	5 cells crépissage complete	33·6	21·9
e 3 o	96		2		7-10-62	selecting site	8-10-62	cell I open	32·9	23·6
e 4 o	61		2		7-10-62	cell IV open	11-10-62	cell IX open crépissage incomplete	33·1	23·1
e 5 o	115	1	2		9-10-62	selecting site	4-11-62	13 cells crépissage complete	33·1	19·2
e 6 o	61		2		29-10-62	cell I sealed	31-10-62	2 cells crépissage complete	30·7	20·6
e 7 o	80		2		21- 3-63	cell I sealed	wasp did not return		35·5	21·7
e 8 o	61		2		13- 4-63	cell I open	21-4-63	cell XI open	39·2	23·0
e 9 o	142		1	net	19- 7-63	cell I open	wasps probably deserted several days previously			
*e*10 i	140			1	24- 9-63	cell II unfinished				
*e*11 i	601	1			15-10-63	abortive brackets	21-10-63	cell V open	33·1	23·1
*e*12 o	80		2		18-10-63	cell I open	18-10-63	cell II open	33.1	24·4
*e*13 o	124		2		17- 2-64	cell I open	20-2-64	cell VII sealed	36·6	17·2
*e*14 o	80		2		1- 3-64	cell I open	7-3-64	VIII open crépissage incomplete	36·8	19·0

*e*15	o	186	2		glass 1	6-3-64	cell IV sealed	6-3-64	unchanged	34·2	19·0
*e*16	o	110	1 curved			12-3-64	cell I open	wasp did not return			
*e*17	o	115	1			22-3-64	selecting site	23-3-64	cell II open	37·6	22·0
*e*18	o	218		2		25-3-64	cell II open	28-3-64	cell IV open	38·0	23·8
*e*19	o	36		2		20-4-64	cell I incomplete	22-4-64	cell I sealed	35·1	21·6
*e*20	o	259		2		7-5-64	cell I open	9-5-64	cell III open	37·1	27·0
*e*21	o	218		2		28-5-64	cell I open	31-5-64	cell II open	38·5	24·2
*e*22	o	213		1		31-5-64	abortive brackets	17-6-64	7 cells crépissage interrupted	42·9	24·6
*e*23	o	140			wire 1	5-6-64	cell II open	19-6-64	cell IX open	42·9	24·5
*e*24	o	96		2		13-6-64	cell II open	14-6-64	cell III sealed	42·1	28·1
*e*25	o	48		1		17-6-64	cell III unfinished	28-6-64	cell X open	35·7	24·5
*m*1	i	639	2			15-7-60	foundation cell I	28-7-60	cell X open	31·0	26·3
*m*2	o	171	1	1		26-9-62	selecting site	28-9-62	foundation cell I	32·1	24·4
*m*3	i	574	1			22-7-63	cell IV open	30-7-63	cell X open	31·8	24·5
*m*4	o	119		2		18-10-63	foundation cell II	30-10-63	cell IX open	33·1	20·5
*m*5	o	96	3			11-12-63	cell I open	19-12-63	cell IX open	30·6	11·3

e = *E. c. esuriens* *m* = *S. madraspatanum* o = outdoors i = indoors

NOTE. The mothers of *e*7, *e*9, *e*10 and *e*16 were *not seen*, the species being identified from the offspring only. We have records of many similar nests which from the form of the pots we are virtually certain were built by the species concerned, but which were either completely parasitised, squatted (Jayakar & Spurway 1964), or yielded no offspring.

All animals except *m*1 were observed in Bhubaneswar: *e*11, *m*3, and a *madraspatanum* seen building on 15-5-63 on plastered wall and metal transformer box and who finally completed at least 15 cells were on the various buildings of the Orissa University of Agriculture and Technology. *e*10 was found on a curtain inside the house Unit 1, Type V-R, No. 12. All other wasps were observed on the various buildings of the house Unit 5, Type VIII, No. 2. As well as the *esuriens* listed in the table one was captured on 17-9-1962 when she had completed 7 cells, one was seen working during October 1962. Finally on 6-3-1964 a wasp put down two loads partly on the foot of a chair and partly on the floor, and on the next day the same, or another, animal put a load on each upper edge of a bolt staple 1-2 m. from the chair. The nests of the unnumbered individuals were all less than 1·25 m. from the ground.

[3]

Considering the wasps observed at the single-storied house Unit 5, Type VIII, No. 2, New Capital, Bhubaneswar, *e*1 - *e*8, *e*12 - *e*14, *e*18 - *e*21, and *e*24 and *m*2 and *m*5 were on a roofed verandah, 15·7 × 2·5 sq.m. × 2·9 m. high, facing 20° west of south.

Both the garden parapet and house wall of this verandah are simple and symmetrical so that they are convenient for mapping and describing in code. The house wall contains four wholly wooden double doors and four windows each with double shutters of similar wood containing small panes of glass in their upper halves. Though the windows are of two sizes, and their frames are somewhat narrower than those of the doors, to human beings all eight structures consist of homologous parts. These structures were numbered (1) - (8) from west to east ; (1) and (8) were small windows, (3) and (6) were large windows and (2), (4), (5) and (7) doors. Two of the nests (*m*2 and *e*5) were built on (3). The cement parapet of the verandah is 51·5 cm. high on the house side and 90 cm. high on the garden side and has a bench-like top 7·5 cm. high and 34 cm. wide. Its wall is of plastered cement and perforated with a simple pattern of square (7·5 × 7·5 sq. cm.) holes and of eight-pointed 'stars' made up of two squares each with sides 15 cm. long superimposed at an angle of 45° to each other. Eight of our nests of *esuriens* (*e*1, *e*2, *e*4, *e*6, *e*7, *e*8, *e*12, *e*14) were built in this parapet in the square holes of the wall. By sticking pieces of transparent cloth over the two openings, these holes were sometimes converted into cages to capture the offspring when they emerged. Some other nests were also covered with cloth but less elegantly. The plastered pillars which interrupt this parapet and support the verandah roof also provided attractive nesting sites. They are ribbed with horizontal grooves 2 cm. high and 0·3 cm. deep. These grooves simulate the layer of mortar between blocks of stone. They also provide a ' floor ' 0·3 cm. wide, and a ' wall ' 2 cm. high sufficient for two rows of cells, the upper one touching a ' ceiling ' 0·3 cm. wide. On the face of the car porch which extends from the central portion of the verandah, the ' ceilings ' of these grooves gradually increase in width relative to the ' floors ' from the ground upwards. The ' floors ' finally disappear so producing a spurious corbelling to form the canopy. Four *esuriens* nests (*e*13, *e*18, *e*20, *e*21) exploited these features. Nests *e* 9, *e*16, *e*17, *e*22, *e*23, and *m*4 were on the opposite or north side of the house facing into a yard, and the remainder scattered about, *e*25 being on a separate building. Nests *e*10, *e*16, *e*17, *e*23, and *m*5 were on articles of furniture. These were not moved after work was discovered. The others were built on permanent fixtures.

Nests *e*1, *e*2, *e*5, *e*8 and *m*2 were watched continuously from discovery during the hours of daylight, and the arrivals and departures of the mothers and various intruders noted to the nearest second, as were their actions on the nest. Not all these data will be used in this paper, but special emphasis will inevitably be laid on these five individuals. The other nests were inspected at irregular intervals, but usually several times a day.

Five wasps, *e*6, *e*14, *e*22, *e*23, and *e*24, were painted for identification, the latter three while etherised ; *e*23 succeeded in removing her first paint put on her abdomen on 8/6 and was re-painted on her thorax on 10/6. She was subsequently captured again on 14/6 and etherised by mistake. All except *e*14 reacted by ceasing to work for a long period, *e*6, *e*22, *e*24, and *e*23 on the second occasion not working again that day. On the first occasion, *e*23 was not seen for 5·3 hours after her recovery from the anæsthetic, and then had not added any loads to the walls of cell III during the building of which she was interrupted. None deserted immediately, but we will later compare the subsequent behaviour of *e*6 and *e*14, who were not under ether when painted, with the behaviour provoked by parasitisation.

SITE SELECTION

Five animals *e*2, *e*3, *e*5, *e*17, and *m*2 were observed before any load had been brought. They were feeling the area with their antennae. *E. esuriens*, like other vespoids, only touch the substrate with the tip of the geniculate antennae to scan it. We have described previously the ‘ sweeping ’ with a large area of the antennae performed by *madraspatanum*.

On 7-10-62 at 14·01 it was prophesied from the behaviour of an *esuriens* that a nest would be built in a certain angle of masonry. No mud was brought that day. The first cell was found open on 8/10 at 11·02. This was nest *e*3. The site of *e*17 was recognised by similar behaviour at 11·25 on 22-3-64. Her choice was on a flat surface of an unvarnished wooden stool. Ten minutes later the wasp had already brought at least two loads.

Wasp *e*2 was observed for 13 minutes hovering and settling on two of the ‘ star ’ holes and one of the square holes near the place where she subsequently built, which was in another square hole. She left for just over six minutes and returned with her first load.

The wasps *m*2 and *e*5 were both observed for considerably longer periods, and both of them made movements that revealed that they appreciated homology in human artifacts.

At 11·10 on 26-9-62, *m*2 was observed to land on window (3) and sweep with the whole length of the antennae (the scanning movement) between a door stop and a hinge 30 cm. below it on the west (observers' left) side of the shutters of (3). During 17 minutes she gradually narrowed her range of exploration to just below the stop. During the next 150 minutes she visited this and four other shutters 17 times, in each case either hovering over the region below the west door stop, sweeping on it, or landing elsewhere on the door and walking to it before sweeping. The periods of sweeping were frequently interrupted by the wasp taking off, and either landing immediately, or hovering within 15 cm. of the place. On two occasions she also touched two different chairs each twice in rapid succession for a few seconds each time. Thirty-eight minutes after she last left, there was just over twenty minutes rain, and light was poor for the rest of the day.

Next day, 27-9-62, *m*2 arrived at 08·36, going straight to her usual place on (3) sweeping and hovering for 112 seconds. She flew up and down the verandah before leaving for the garden. At 10·07 she deposited her first load of mud under the shutter stop of (3). During the intervening period she had made four loadless visits of 150, 17, 32, and 11 seconds respectively, all to the same place and all involving hovering, and associated with flying round the verandah and even touching objects.

We think this long exploratory period to be exceptional. It had not been made by *m*1 and, whereas *m*1 built a normal nest, *m*2 deserted almost immediately ; perhaps *m*2 was never completely satisfied with this site, or perhaps she was not highly motivated. However, there is no doubt that she appreciated certain homologous features of the doors and shutters that a human also does.

On 9-10-62, an *esuriens* was flying around the porch, verandah, and parapet from about 09·40 to 10·39, settling many times. We think that there was only one wasp. At 11·04, *e*5 entered, and from 11·07 concentrated on the lower surface of a wicker work chair (Chair 1). This was one of two similar chairs placed close together side by side facing south. The observers were sitting in them checking that *e*2 had left her nest finally. By 11·14 at least, *e*5 was concentrating on a particular place among the struts under Chair 1 on its right side. She left at 11·20 after flying round Chair 1 and the adjacent parapet. Chair 1, which was to the west, was laid on its right side facing south and the other chair, 2, was turned through 90° so it was facing west and the under side of the first chair. An observer sat in Chair 2. At 11·20, *e*5 returned without a load. For 29 minutes she flew round Chair 1 leaving for the garden repeatedly for a few seconds at a time. She settled on the floor under Chair 1, but did not find her previously preferred place nor any substitute for it. She then flew under Chair 2 walking on the struts. She found the place homologous to her site on Chair 1 among the struts on the right side of Chair 2 in about 71 seconds. She investigated adjacent places but returned to her first choice on Chair 2 and made it her definitive choice, as was shown by her bringing mud to it on her next visit. If this homologous choice was significant, the chairs provided all the environment that determined it. She did not select a point which had a comparable position with regard to the garden, or the parapet or other features of the verandah. She came from below Chair 2 at 12·00, and flew round and under Chair 2 and its occupant repeatedly before leaving 4 minutes later.

Chair 2 was then laid on its left side so that the under side was facing west and also the under side of Chair 1. Both chairs were now facing south. After 6 minutes, at 12·10, *e*5 returned with a ball of mud. Until 12·18 she flew round this region of the verandah and in and out of the garden repeatedly. She flew low over the parapet on which many objects were standing, apparently checking the presence of things to which she had orientated. At 12·15, she dropped her mud. She touched one of the observers thrice and once landed on the now vertical under side of Chair 2.

She (presumably the same wasp) returned at 12·24 without a load and continued flying round the chairs and both observers. At 12·28 she landed on a small table and at 12·29 flew to window (3) previously used by *m*2. In exactly a minute of hovering she had landed three times, the last on the west bottom corner where she later built her nest partly on the concrete horizontal sill, the concrete vertical wall, and the wooden frame (Figs. 2-5, and 7 and 8). She never settled on any other region but hovered over this, settled, and walked round it repeatedly. She continued thus while the sill was emptied of various pieces of household and laboratory equipment. At 12·42 she returned to Chair 2 for 12 seconds. She continued her survey and nibbled at material in the corner of window (3). At 12·54 she left the immediate area of the west bottom corner of window (3) and made a fresh orientation flight flying round the window and verandah and over the parapet in gradually widening circles. She left at 12·56, and returned with mud at 12·59. Therefore *e*5 took 140 (or 14) minutes to select her first site, 16 minutes for the second, 28 minutes for the third.

We saw *e*11 bring her first load and put it where she finally built. However, 2 hours later, and before she had completed the ring of her first cell, three other loads had been put down elsewhere, two worked together 7 cm. above cell I and a single one about 24 cm. above cell I; all three sites being in a straight line, one above the other. Such depositions have the form of the brackets with which cell walls are begun and we consider them *abortive brackets*.

At 14·55 on 31-5-64, there were 4 parallel brackets and the stain of a ring made of several loads which seemed to have been removed on the *west* edge of a pillar supporting a verandah roof (Fig. 1). A wasp was present constructing a bracket 7 mm. from the *east* edge of the same pillar at 60° to the west brackets. No further work was done that day. On 1-6-64 at 13·45, *e*22 was working on a ring about ⅓ complete 10 cm. above the bracket seen laid down on the previous day. On the east side, there was also one one-load bracket and a partial ring which we did not see put down. By 13·47 she was adding mud to this latter on which she put down all subsequent loads so it therefore became the definitive nest. At 14·07 however, she landed on the abortive bracket on which she was first seen working on 1/6 but walked up to the definitive site before putting down the mud. It is of course not critical but we assume that the

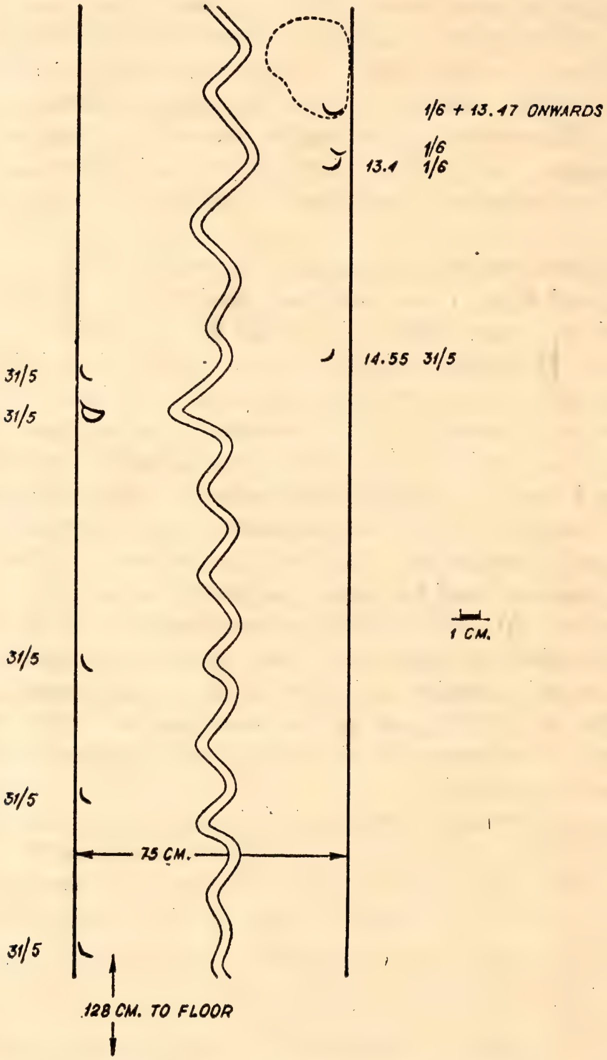

Fig. 1. *e*22. 1-6-64 13·47. Nine separate beginnings of cell construction, and the times these were laid down in as much detail as is known.

After 13·47 all loads were used to construct the 7-celled nest here indicated by a dotted outline, the remaining eight depositions remaining abortive.

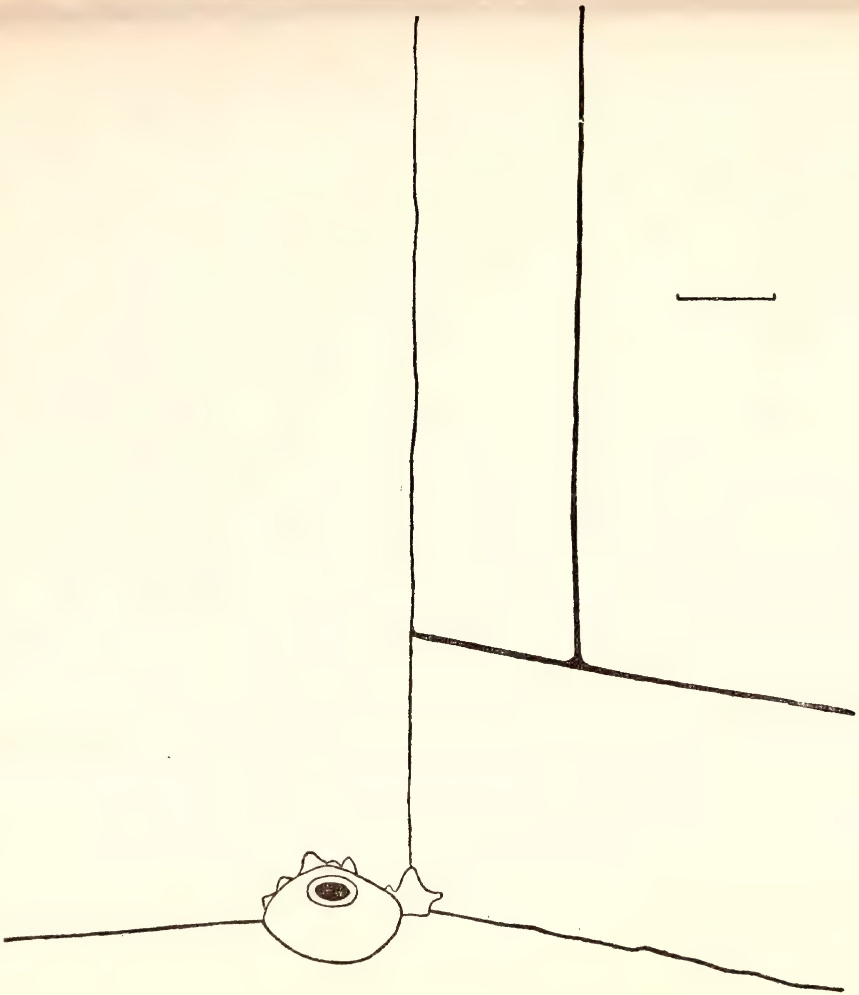

Fig. 2.

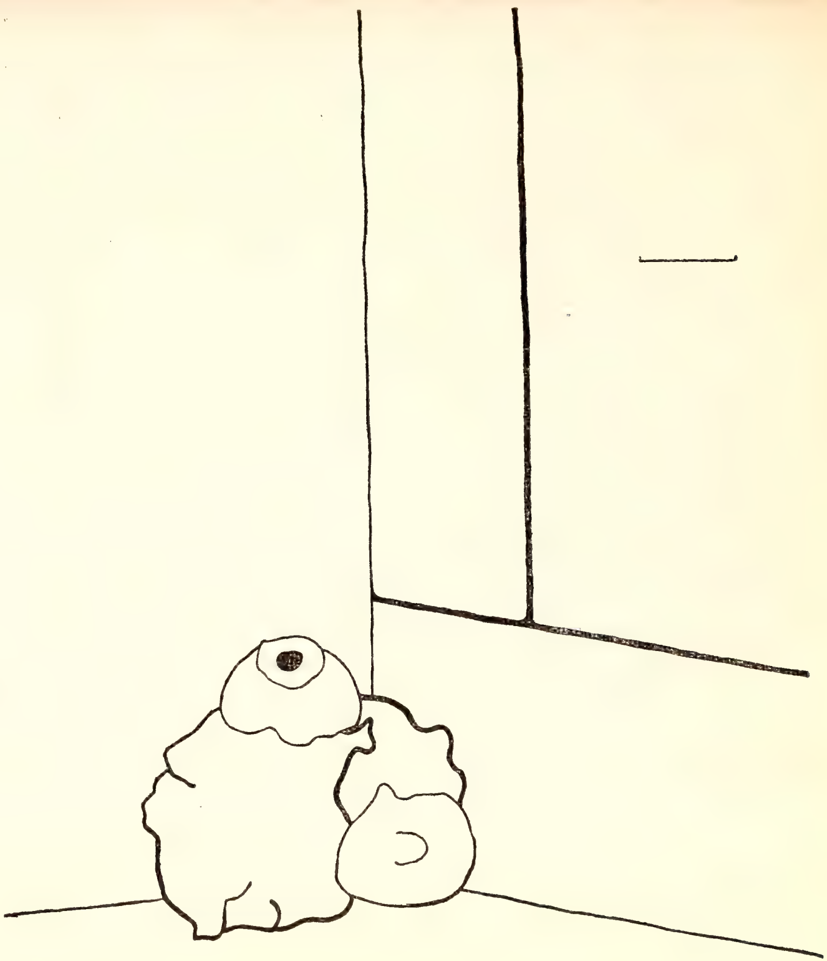

Fig. 3.

Nests of *Eumenes campaniformis esuriens* (Fabr.)

(For legend, see overleaf)

Fig. 2. *e*5. 9-10-62, 13.56.30. Cell I newly built and open. The layer of mud to the observer's right is filling the chinks between the wooden shutter and the masonry sill and jamb.

Fig. 3. *e*5. 15-10-62, 15.23.55. Cell VI newly built and open. Cell V on sill and shutter in front of I is sealed but not daubed. Four earlier cells united by daubing so that individual structure obliterated (the small horizontal line accompanying each figure represent 1 cm.).

abortive brackets found on 31/5 were put down by *e*22. She certainly worked at two sites on 1/6.

Two deserted brackets orientated to one another and thus forming the beginning of a cell were found 7 cm. to the south of cell I of *e*21 with a parallel alignment in the horizontal grooves on the verandah pillars described above.

Foundations

As previously described, *madraspatanum* begins each cell by spreading mud over any part of the substrate that will form any part of the floor of the next cell, which will have the form of a vault about 24 mm. long and 9 mm. high. There is no sign of such activity in *esuriens*, the floor of whose cells consists of the naked substrate. However, *e*5 often smeared a little mud outwards from some of the loads with which she built her walls. These smears filled in gaps between the wooden shutter frame and the concrete sill and jamb, which gaps were relatively large compared with the diameter of *esuriens* cells (Fig. 2).

It seems that *madraspatanum* usually builds on wood and on a vertical surface immediately *under* and touching a projecting surface, here called a ceiling. *E. esuriens* wasps built more frequently on masonry and more frequently *upon* a horizontal surface, here called a floor, and touching a vertical surface. Both species sometimes build on a single completely flat surface. Two individuals, *e*10 and *e*23, built on more recently developed human artifacts ; *e*10 on the hem of glass-net curtains and *e*23 on the wire, 5-6 mm. in diameter, which forms the skeleton of a bicycle seat. We have seen cells presumably constructed by *esuriens* on the spokes of a bicycle wheel. We did not see the complete pots *e*10 I, and *e*23 I being built, and the position of nest *e*23 made the construction of later cells difficult to see. In this nest five cells I, II, III, VI, and VIII all had complete floors, but except I, all were built overlapping a previous cell, and so were at best $\frac{3}{4}$ pots. When nest *e*23 was removed, a groove was present in the outer surface of its solid floor as the pots had been built partially enclosing the wire. The inner surface of these cells must have passed through a saucer stage comparable to that pictured by Olberg (1959, p. 122) for *E. pedunculatus* and mud was added to the rims of these saucers in the same way as it was added to the walls of the pots (see below). From fragmentary observations it seems that the saucers were begun as a pair of brackets one on either side of the wire, the first loads being put down touching one another, as we have seen the similar saucer stage constructed by *E. emarginatus conoideus* (Jayakar & Spurway, 1965) and these two brackets were separately added to. We saw no movements suggesting that the wasps worked continuously round the edge as wasps do when the circumference is again small when the shoulders and neck of the pot are formed.

CELL WALLS AND BUILDING BEHAVIOUR

The round half pots built by *esuriens* are constructed from two or three foci. A load of mud is brought and gradually laid down first to one side and then to the other until a crescent-shaped bracket is formed which is then pressed between the mandibles and the front legs and smoothed by these organs both on the inside and the outside. Unlike *madraspatanum* wasps, who straddle the working edge of their vaults with the appendages of one side of the body inside and the other outside, a *Eumenes* wasp's body and legs are always outside the bracket and both antennae and both mandibles inside it. The long axis of the sphecoid species is parallel to her line of work, and the mud is rolled out in her sagittal plane. The long axis of the *Eumenes* is at right angles to her line of work, and the mud is extended in the transverse plane of her body. These positions for work are not taxonomic criteria characteristic of the Vespoidea and Sphecoidea respectively, for the vespoid *Polistes olivaceus* also straddles its cells while laying down paper. However, *Polistes* and *Eumenes* individuals were completely silent while laying down material, whereas individuals of *madraspatanum* keep up a continuous buzzing while working their mud, both when collecting it and when working it on the construct. This noise was the most critical stimulus by which to time when a load was put down after a preliminary period of feeling. It is also performed by the closely related *Chalybion bengalense*, and the much less closely related *Trypoxylon pileatum*.

The *esuriens* wasp holds her mud between her mouth and her forelegs, laying it down a little at a time. Therefore she can cease work in a place, lift her ball, and transfer it neatly to another place without trailing strings of sticky mud after her. In this again they differ from *madraspatanum*, who immediately put down their loads, roll them out roughly in their permanent position, and then work backwards and forwards over them, exactly as pastry is rolled repeatedly. The mud working of *esuriens* can similarly be compared to the construction of ribbons of sugar icing by thrusting this through a funnel so that the rest of the load can be separated from the part already put down, and be picked up and distributed to several separate parts of the construct. As will be described, *esuriens* does sometimes construct ribbons of mud very similar to those made with sugar icing by this method.

The first loads brought by *e*2 and *e*5 were smaller than subsequent loads and the following figures show, for each wasp, how many times she used only a part of a load to start a new cell (excluding the first cell) :

*e*1	1 out of 3,
*e*2	0 out of 4,
*e*5	6 out of 12,
*e*8	8 out of 9.

Of the 31 complete cells we watched being built by *esuriens*, 20 were constructed from 3 foci and 11 from only 2. Before the laying down of these first brackets the tips of the antennae can be seen feeling the substrate, also in an arc. Loads need not be placed on brackets alternately. A load is usually worked on one single bracket which is raised and extended in length either symmetrically or asymmetrically. Gradually the brackets are joined to form a continuous ring. Only during the joining up process are loads put down between brackets. Antennal feeling of the construct is continuous.

On four occasions *e*1, *e*2, and *e*5 daubed the previous construct while a cell was still unfinished, whereas *e*8 did it very often and once daubed six successive loads on her earlier cells in the middle of building a new one. Daubing was the activity that preceded wall-building, but it is possible that these daubs played some functional part in the cells the walls of which were being raised. *S. madraspatanum* occasionally lays down a daub between adding loads to a wall.

On three occasions *e*2, and on four occasions *e*8, *killed an ant* running over the cells by *putting a lump of mud on top of it*, and partly smoothing this out but leaving the ant buried alive as a rough knob on the wall of the pot. We have found no previous description of this capacity. The manner in which the ant was chased and ‘swatted’ leaves no doubt that this method of killing is deliberate, and not a fortuitous accident due to the ant being in the way of the work.

The joining of all the brackets of one cell was completed with the seventh load and once with the eighth, but it usually requires between 9 and 15 loads as part of the wall may be built up while the remainder is still unconnected. When all brackets had been joined, the walls were usually about 3-4 mm. high but, especially when pots were built on others, and thus on an uneven surface, this was very variable. The diameters of the completed rings were between 15 and 20 mm. At this stage the five complete pots of *e*23 were little bowls of similar diameter. Their later history resembled that of the half pots, further loads being put on the rings which were worked for increasingly greater arcs of their circumferences as the diameters were gradually narrowed with each load.

With the first load that was worked completely round the circumference, the hole of both a half and a whole pot was reduced to about 4 mm. diameter, and usually the *neck* was begun by pulling up part of the mud to form a little tube. The next load was added to this tube lengthening it. The tubes were then pressed at right angles to the length of the tube to form a flat *lip* to the pot. Occasionally the neck was left incomplete, being formed in one part of the rim only, and another load was fetched to complete it.

On seven occasions, the neck and the lip were made from three loads of mud, on seventeen from two loads, and five times both were completed out of one load of mud. On the remaining occasion *e*8 had worked on the neck and lip of cell IV with one load, but when she brought her next, she was disturbed by an ant. She dropped the mud, spent 371 seconds on the nest without doing anything obviously constructive, then left. She did not return that day, but the next morning she oviposited in that cell without putting any mud on it and then continued as usual from there. In the completed pot, the neck is very short and perhaps should be considered as a temporary stage in lip formation. The lipped mouths always faced at an angle of about 45° from the vertical and were inclined towards the direction in which the cell received maximum illumination. After a pot had been finished, the egg was laid, food was provided, and the cell sealed and very frequently daubed. These activities will be considered in the following sections. The mother usually then began another cell. We have assumed that wasp *e*10 began, 30 cm. from her first construct, another isolated pot which she did not complete ; but in all nests that we saw constructed, the *esuriens* mothers built their later pots overlapping one or more previously constructed. Whether or not these previous pots had been daubed, the first 2 or 3 brackets of the later ones were always orientated to them so that one or more rows of overlapping pots were formed (Figs. 2, 3, 4 and 5).

This overlapping construction results in the wall area of all later pots being less than the first and those built on two or more may be little more geometrically than a third of a sphere. The orientation of the mouth in later pots is again at about 45° from the vertical and as they are orientated to the source of light or the approach route of the mother they are usually roughly parallel.

This was not true in nest *e*23, and it may perhaps be relevant that the mother flew under the bicycle saddle from several directions. In this nest, cells IV, V, VII, and IX formed a typical second row, of typical half pots, their floors being formed of the walls of the pots on which they rested.

Individuals of *madraspatanum* also build their cells touching previous cells but they do not overlap so as to certainly economise on material. As has been noted, these later cells are not so regularly built as the earlier ones on a flat substrate.

Table 2 shows the numbers of loads put to different uses in pot building and the numbers up to various stages of the cells. The differences between nests within this species are clear from the table, the four means being 19·5, 17·40±0·51, 15·85±0·53, and 15·00±0·54, and the variances of *e*2, *e*5, and *e*8 being 1·30, 3·64, and 2·89 respectively. It is possible

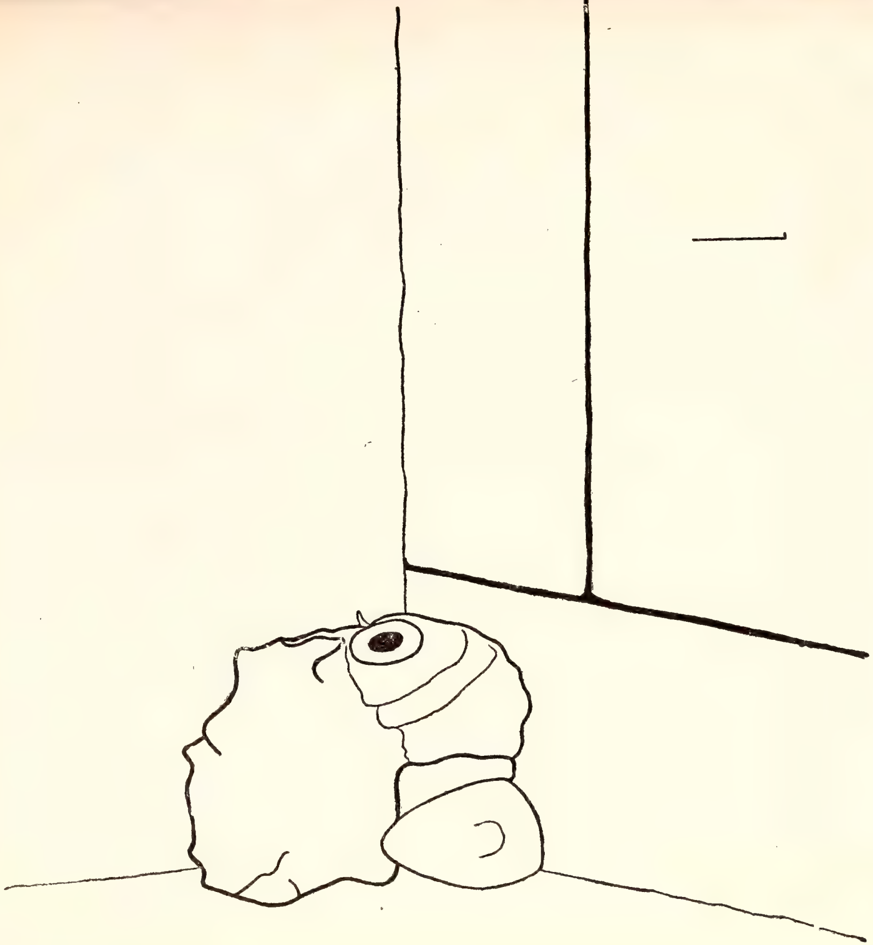

Fig. 4.

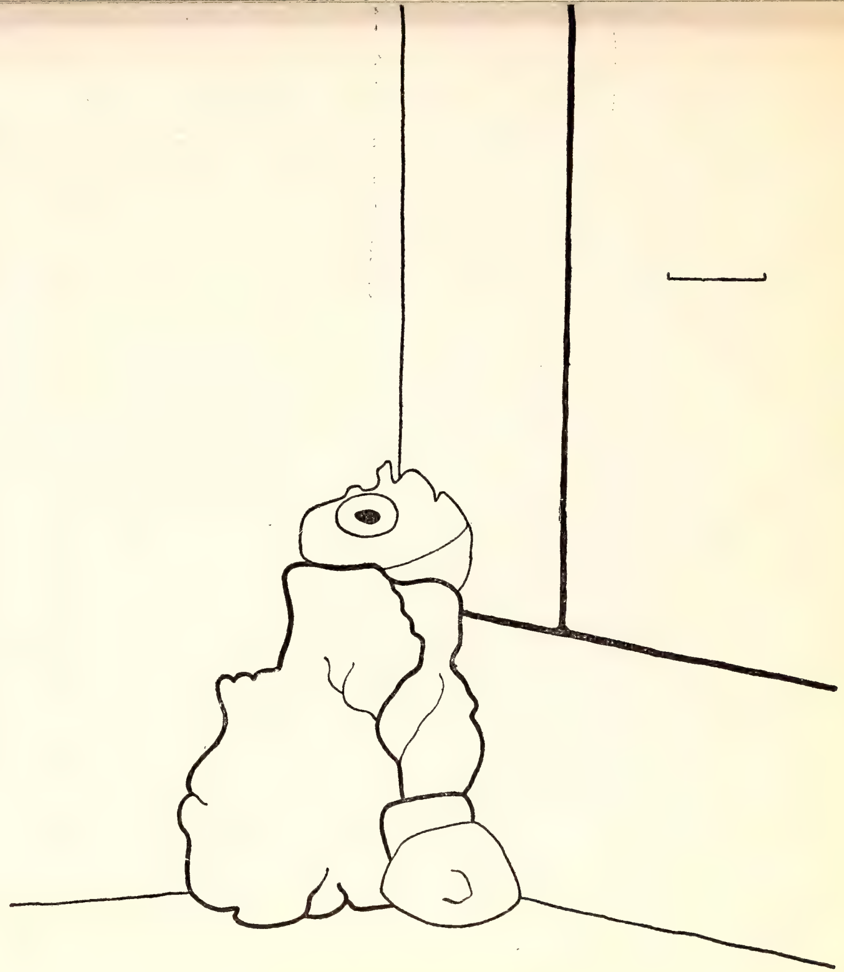

Fig. 5.

Nests of *Eumenes campaniformis esuriens* (Fabr.)
(For legend, see overleaf)

Fig. 4. *e*5. 16-10-62, 14.20.03. Cell VII newly built and open. Cell VI, now joined to earlier cells by daubing.

Fig. 5. *e*5. 19-10-62, 12.57.21. Cell IX newly built and open. Cell VIII now sealed and daubed is immediately below IX and was built on both VI and VII. Cells X, XI, XII and XIII were later built in a column above IX (the small horizontal line accompanying each figure represents 1 cm.).

TABLE 2

NUMBER OF LOADS USED IN CELL BUILDING (*E. c. esuriens*)

Nest	Cell	daub	smear	smear + wall	wall	ant	dropped	Total	No. of loads up to			
									A*	B	C	D
1	II	½ ½			17			18	11	16	16	18
	III				21			21	13	20	19	20
2	I				17 ½	1 ½		19	9	17	17	18
	II				16			16	8	14	14	15
	III				17			17	10	16	16	17
	IV				17 ½	½		18	10	16	17	18
	V				17			17	10	16	16	17
5	I			1	16			17	12	16	16	17
	II	½			14 ½			15	10	14	14	15
	III	½			13 ½			14	9	14	14	14
	IV		½		11 ½			12	10	12	11	12
	V		½	1	12		½	14	9	13	13	14
	VI	½			14 ½			15	10	13	13	14
	VII		½ ½ ½		13 ½			15	12	14	14	15
	VIII	½		1	15 ½			17	12	16	16	17
	IX			2	14			16	10	15	15	16
	X		½	1 ½	17			19	11	18	17	19
	XI	½ ½	½	1	17 ½			20	15	20	19	20
	XII		½	1	16 ½			18	15	18	18	18
	XIII	½ ½		2	15			18	13	17	17	17
8	II	⅔ ½ ½			11 ⅓			13	10	12	13	13
	III	¾			13 ¼			14	10	12	13	13
	IV	⅔ ½			10 ⅚		1	13	9	11	12	12
	V	½ ⅔			12 ⅚	½ ½		15	9	13	13	14
	VI	½			13	½		14	9	12	13	14
	VII	½ ½			13			14	10	14	13	14
	VIII	½ ½			15			16	9	15	15	15
	IX	½			16			17	11	16	16	17
	X	½			15	½		16	11	14	15	16
	XI	½ ½ ½	½	½	16 ½			19	14	19	18	19

½ (or ⅓) load indicates that the same load was used in 2 (or 3) discrete actions.
*A—joining all brackets ; B—working one load round the whole circumference ; C—beginning the neck ; D—beginning the lip.

that these differences are entirely due to external factors (site of nest, weather, etc.). The mean number of loads for all cells is 16·23±·041, with a coefficient of variation of 13·8 %, compared with 11 % for *m*1.

A cell of *madraspatanum* is a little vault, not ‘ a cylinder puckered at both ends ’ as stated by Iwata (1942). These are built from one focus, formed by the first *two* loads laid down in the same way as the later loads, unlike the cells of the North American species described by the Peckhams (1905). A cell is completed by the gradual narrowing of the floor under the vault and the joining of the wall to form the circular mouth. This is not characterised by a special series of movements as in *esuriens*. *m*1 used 24 to 31 loads, mean 26·3, for a cell.

Eumenes wasps never enter their pots while building them. In this again they differ from *madraspatanum*, who enters her vault after laying down each load. *S. madraspatanum* feels her construct for much longer periods than *esuriens*, and in all her construction it seems probable that this examination frequently determines where the next load will be placed before this load is collected.

Though the period of working the mud is not the whole period between landing with a load and taking off for another, the much greater variation in the technique of wall-building of *esuriens* compared with *madraspatanum* shows itself in the greater variation of the actual working periods. Some features of the distributions of times spent on the nest during visits when the wasps worked on the walls are compared for the different wasps of both species in Table 3. Those statistics which were calculated for *m*1 are here compared with those for the various individual *esuriens*. The two estimates of the standard error of the median in this and several other Tables in this paper are discussed by Spurway *et al.* (1964).

TABLE 3

TIMES SPENT *on* NEST WHILE BUILDING WALLS

	*m*1	*e*1	*e*2	*e*5	*e*8
no. of cells timed ..	10	2+	5	13	10
no. of timed visits ..	263	37	83	190	125
shortest visit ..	20	36	38	27	29
longest visit ..	246	134	313	187	201
mean ..	44·56	63·03	65·40	84·62	73·34
s.e. of mean ..	1·13	3·26	4·40	2·15	2·38
median ..	41·60	59.75	59·38	79·33	69·00
s.e. (1) of median ..	1·01	2·74	1·29	1·92	2·75
s.e. (2) of median ..	0·85	4·11	1·87	2·93	2·00
$\frac{\text{IQR}}{\text{median}}$ % ..	34	45	31	55	35
C.O.V. %	41·0	31·5	61·3	35·0	36·3

During the building of each cell, the length of time taken to add a load gradually increases, as the proportion of the circumference worked increases. The mean length of the periods on the cell are graphed in Fig. 6. The periods during which the neck and lip were constructed are omitted. These are even longer and involve movements not used in earlier wall-making. The data are graphed twice. In the graph indicated by circles, the first visits to the thirty cells entirely spent on wall-building are averaged, then the second similarly, and so on. In the graph indicated by squares, the highest value in the top right hand corner is the average of the 30 times during which the last load before neck building was worked. The square with the abscissa of 17 is the average of the last load but one and so on. This second graph is the more smooth, and theoretically this is to be expected. The later part of a pot is a taxonomic character of the species, and the movements with

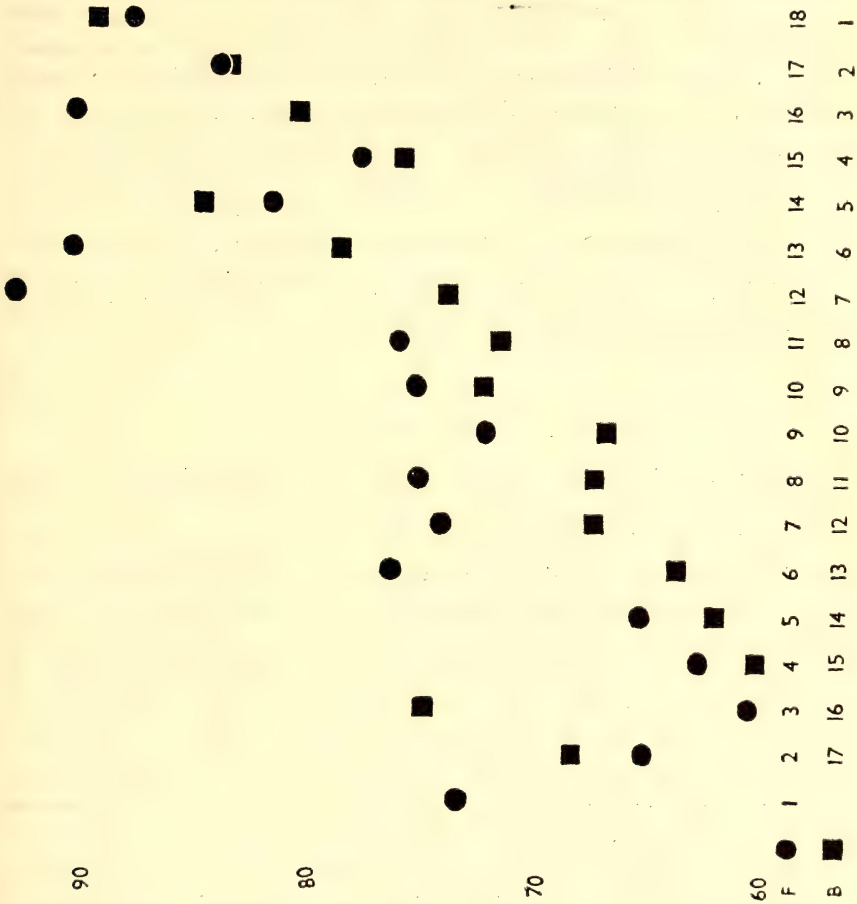

Fig. 6. Graphs showing increase in time taken to add a load of mud as cell building progresses—see text.

which it is made would be expected to be almost pure *erbkoordinazionen* and extremely standardised in all individuals. Therefore when we average, for example, the time taken over the last load before the neck, we are averaging something precisely defined which is a taxonomic character of the species. On the contrary, the first loads of a pot attach it to its substrate and therefore, to function at all, must differ for every single pot. They must be determined in important respects by the special features of the environment on which this particular pot is constructed, and the movements of building the early part of a pot must have a large *taxis komponent* which will decrease as the walls grow and their form becomes independent of the immediate substrate. Therefore these early movements are not to be expected to be equivalent from one cell to another, and it is satisfying that averaging the times expended on them provides as smooth a graph as it does.

OVIPOSITION

Oviposition differs in the two species, and these differences have important consequences in their economies.

Immediately after completing the lip of the pot, which has been a period of great activity during which the tips of both antennae were inside it, the *esuriens* wasps removed these and inserted the tip of their abdomen. They remained in this position for some time (Table 4). The abdomen was then removed, and after another few seconds of antennal feeling they flew away, usually for the best part of an hour or more and on occasions for the night. The egg was usually visible, cylindrical and pearly, hanging from the zenith of the pot, i.e., quite near the opening. Thus an *esuriens* cell is never left empty and this is typical of the genus and related genera. However, on 3 occasions (i.e. cells IV, VI, and VIII), *e*8 did not oviposit immediately but did so on a subsequent visit, in IV not until the next day (Table 4). We consider this behaviour abnormal, the reason for which in the case of cell IV and cell VI was probably disturbance by ants, but for cell VIII is not clear. *e*6 seems to have delayed laying in her cell II.

S. madraspatanum wasps, as is typical of their genus, oviposited only after they had captured and brought prey to the cell. They entered the cell abdomen first and disappeared completely for many seconds during which time an egg was laid attached to the prey.

The evolutionary significance of whether or not a period of hunting has to intervene before an egg is laid is considered by Roubaud (1916), Wheeler (1923), and Iwata (1942). The latter condition is considered the more advanced and to be an essential stage in the evolution of the social forms. However, *madraspatanum* is like *esuriens* and at least one European *Sceliphron* species (Fabre 1924), and unlike North American

S. cementarium (Peckham & Peckham 1905, Shafer 1949), in laying her eggs at the beginning of the provisioning period.

Table 4

Interval (in secs.) between insertion of the abdomen and its removal for all ovipositions of *esuriens* timed

Wasp	Cell	First egg	Second egg	Third egg
*e*1	II	66		
	III	60		
*e*2	I	63	77	
	II	63		
	III	64		
	IV	55		
	V	54		
*e*4	VIII	66		
	X	75		
*e*5	I	66		
	II	71	89	
	III	79*		
	IV	74	111	
	V	85		
	VI	73*		
	VII	84	98	
	VIII	84*		
	IX	95		
	X	87		
	XI	127	188	
	XII	100	63	87
	XIII	78*	73	
*e*8	II	54		
	III	64		
	IV	(66)		
	V	55*		
	VI	(59)		
	VII	59		
	VIII	(60)*		
	IX	57		
	X	54		
	XI	70		
*e*11	III	281		
	IV	51		
*e*14	III	75		
	IV	60		
	VI	97		
*e*21	II	57		
*e*22	I	65		
*e*22	VII	64		

Note : Brackets indicate that the first egg was not laid on the journey on which the cell was completed.

An asterisk indicates that this was the second egg of a day.

In both *esuriens* and *madraspatanum* nests, sealed cells are occasionally found in which no wasp larva can be found and only paralysed or mummified prey. The egg may have died—if of genetic causes, this would explain why there are frequently more than one in a nest, e.g. *m*3. Species with haploid males would be expected to be particularly vulnerable to death due to the segregation of recessive lethals. No evidence on this point can be obtained from the sex ratio as the method of sex determination prevents there being any *a priori* expectation of this.

These cells with uneaten provisions seem commoner in *madraspatanum*. Iwata (1964) explains this by the preference of this species for mud which contains organisms that cause the paralysed prey to deteriorate. However, the observation that the extremely similar *S. cementarium* lays its eggs on a later spider may provide another explanation. Just as *esuriens* (*e*10 and *e*23) occasionally, by building complete pot cells, behaves in a manner which is more frequent in related species, so *madraspatanum* may occasionally behave like another species and not lay as she inserts the first spider into an empty cell. However, to compensate for this, she must perform another unusual act several hours later, i.e., lay on a spider when her cell is almost or quite full. Unusual behaviour on two occasions rapidly following one another and co-ordinated is too much to expect, so no egg is put in the cell. Eumenids also occasionally seal cells without either laying or provisioning. We have seen this in *E. emarginatus conoideus* and our local form of *Antodynerus flavescens*. Roubaud (1916) gives examples in *E. tinctor*.

Normally, only one oviposition takes place in a cell, and we have never seen two larvae reared in any. We have previously described the repeated layings of *m*1 which deliberately compensated for the accidental removal of the relevant spiders which she knew to have occurred.

Considering the 30 cells of *esuriens* we watched continuously, five were laid in twice, and 1 three times (Table 4) ! Wasps emerged from all six cells. All but one of these extra ovipositions were made by *e*5. All extra ovipositions were made on the first visit of a morning or at least before any loads were brought[1], and after prolonged feeling with the antennae inside the cell. Two abortive attempts, one of 150 seconds and one of 76 seconds, were made in laying nest 5 cell XII egg 2 before it was produced by the third effort lasting 66 seconds. We at first believed that the extra ovipositions were made because the first egg had deteriorated by being left in an unsealed cell too long due to delays in provisioning. These delays were *not* due to difficulty in finding prey, but because the mother was unable to work during rain. The discovery of *e*9 and *e*16, the latter during the dry season, made this interpretation less likely. Both were single cells deserted unsealed, and both were not dissected until the larvae had spun their cocoons thus providing with their silk the first closure of their cells. The larvae pupated and developed

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[1] However *e*22, who had completed cell II by 09·46 on 4-6-64 was ovipositing in it, presumably for a second time, on 5/6 just before 17·48, again after a long inspection.

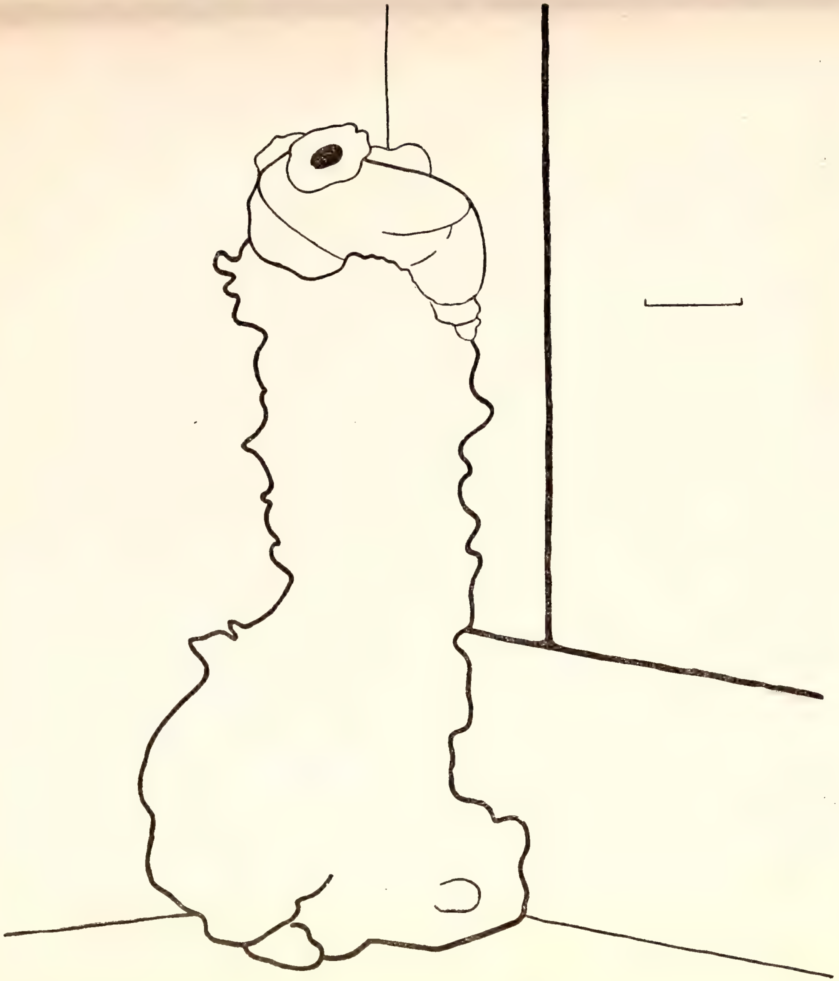

Fig. 7

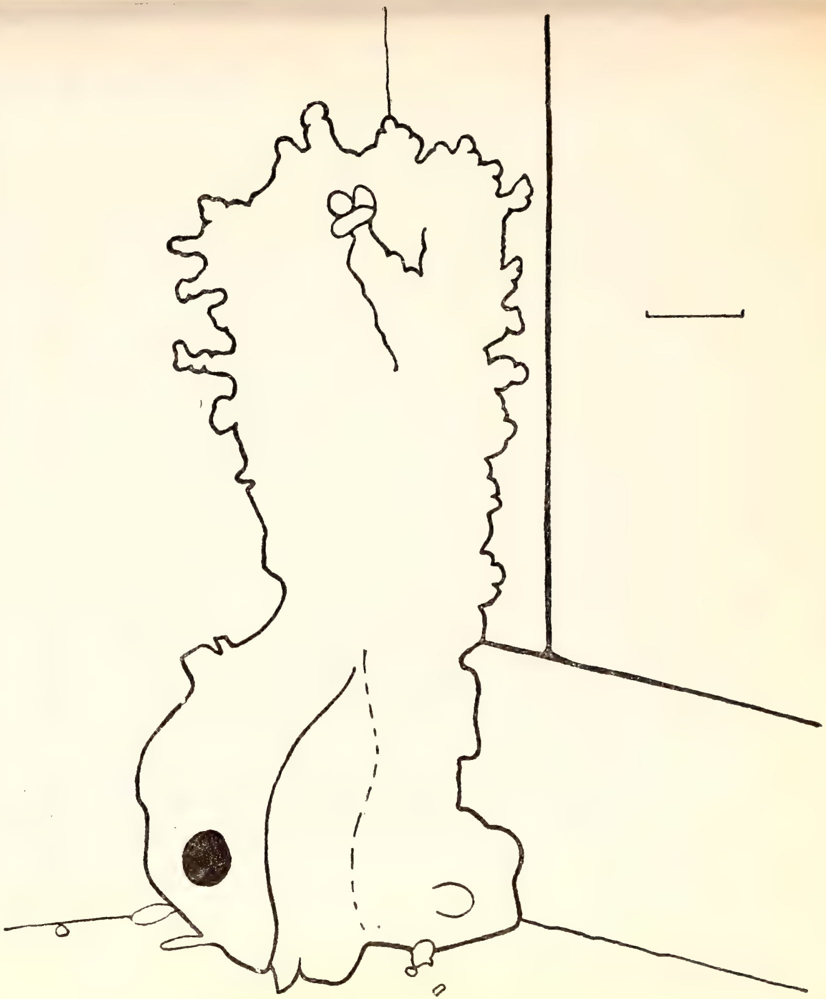

Fig. 8

Nests of *Eumenes campaniformis esuriens* (Fabr.)
(For legend, see overleaf)

Fig. 7. *e*5. 31-10-62, 15.17.41. Cell XIII newly built and open. All previous cells daubed.

Fig. 8. *e*5. 3-11-62, 10.09.42. Completed crêpissage confined to later cells, the daubing on the earlier cells being left uncovered. The hole and lid made by ♂ emerging from cell II are present.

their imaginal coloration. *e*9 I emerged, *e*16 I died before emergence. Given the humidity in October 1962 it is most unlikely that the eggs laid by *e*2 and *e*5 had dried up, which would imply that the chorion in this species is quite unlike that of its relatives, solitary or social, who habitually practice progressive provisioning. The first egg, whenever we could see it, was however wrinkled, flattened, and shrunken when the second was laid. It had perhaps hatched, and the female failing to receive the stimuli she expected from it, re-oviposited.

Roubaud (1916) compares extra eggs laid by *E. tinctor* Christ with other units of abnormal behaviour which are obviously dysgenic, and which we have not seen in *esuriens.* He considers these abnormalities to be characteristic of the end of the breeding season in the region concerned. At this time, the mother is often unable to collect sufficient material to complete one phase of the rearing cycle efficiently before internal physiological changes project her into the next phase of the instinctive sequence. From Roubaud's description, much of the abnormal behaviour of *E. tinctor* seems to us to consist of displacement activities, which would be expected to be stimulated by frustration due to the depauperate environment which he describes. The extra ovipositions of *e*2 and *e*5 however were ordered responses to stimuli which they had obtained during a period of appetitive behaviour which was normal in their daily cycle of behaviour, i.e. the prolonged early morning examination of the construct and the contents of an open cell. Such a response to such stimuli, if it exists as we have suggested, must be lost during the evolution of the capacity for progressive provisioning.

Roubaud considers that when more than one egg is laid within a cell, the wasp that emerges has developed from the first laid, and has eaten its younger siblings together with the prey provided by the mother.

Table 5 lists the data on the relevant families and the only other animal comparably timed at that season of the year. The times of oviposition were known. The *maximum* length of imaginal life is calculated on the assumption that the animal had emerged the moment it was recorded in the cages made by closing the holes in the parapet walls with gauze. As the animals emerged during the morning when they were quickly noticed the error introduced is known to be irrelevant to the argument. On two occasions we watched the emergence. Considering the sex of the individual and the temperatures during pre-imaginal life it will be seen that for four animals (2 I, 5 II, 5 IV and 5 VII) the length of the period in the cell supports the theory that it arose from the first egg laid in the cell. In 5 IX, though the length of pre-imaginal life calculated on the assumption that the second egg produced the wasp is numerically closer to that observed in wasps developing at comparable temperatures, it would be shorter than any unequivocal time observed. Finally, on the numerical data, the middle egg laid in 5 XII would seem to be the one that produced the wasp. This is not impossible. However, when we later consider the length of pre-imaginal life, we will accept Roubaud's hypothesis that the wasp emerging from a cell developed from the first egg laid.

TABLE 5 (SEE TEXT)

Cell	Egg	Temperature during pre-imaginal life		Sex	Max. pre-imaginal life					
		max. (avg.)	min. (avg.)		d.	h.	d.	h.	d.	h.
2.I	1	30·7	22·1	♀	21	04				
	2	30·6	22·0				20	08		
II		30·3	22·0	♀	21	20				
III		29·6	21·9	♀	22	22				
IV		29·7	21·9	♀	22	22				
V		29·4	21·8	♀	24	23				
5 II	1	29·1	21·4	♀	23	18				
	2	29·0	21·3				22	01		
III		29·2	21·2	♂	23	19				
IV	1	29·2	20·8	♂	24	18				
	2	29·1	20·8				23	22		
VII	1	29·0	19·9	♀	25	20				
	2	29·1	19·7				24	03		
VIII		29·2	19·3	♀	25	22				
IX		29·1	19·2	♀	25	22				
X		29·1	19·0	♀	25	19				
XI	1	29·1	18·8	♀	26	19				
	2	29·1	18·7				25	01		
XII	1	29·2	18·1	♀	30	06				
	2	29·6	17·6				27	08		
	3	29·9	16·7						23	10
6 II	2	29·9	16·8	♂	20	23				

d.=days h.=hours

PROVISIONING

It has already been stated that members of *S. madraspatanum*, like other members of the genus, fill their cells with spiders to feed their young, and *m*1 unexpectedly also brought three flies about the size of houseflies.

E. esuriens provision with insect larvae that have a diffuse nervous system (Roubaud 1916). The wasps did not seem to find aggregates of prey from which they could collect a series of individuals in rapid succession. Considering the commonness of their prey only a few metres from the nest, the length of the periods away before bringing prey were surprising (Table 6). This species seems to have a wider range of prey than is usual for the genus (Iwata 1942). Though we have not yet identified any larvae from the nests we watched being built, among these we have seen : campodeiform coleopteran larvae of the wire-worm facies ; geometrid, semi-looper noctuid, lycaenid, and pierid (almost certainly *Catopsilia pyranthe*) larvae among the lepidoptera ; an apodous and at least two eruciform larvae about which we cannot say more. Such an eclectic choice of prey is characteristic of species that have become human commensals. We have previously noted it for *m*1. However, it may be significant that most prey brought during September and October 1962 were of one species (the presumed *Catopsilia pyranthe*) whereas almost all brought during April 1963 were those of a semi-looper noctuid species.

TABLE 6

TIME SPENT *away* FROM NEST IMMEDIATELY BEFORE BRINGING PREY

	*m*1 doubtful prey	*m*1 certain prey	*m*1 oviposition prey	*e*1	*e*2	*e*5	*e*8
no. of timed absences ..	18	55	12	11	28	73	61
shortest period ..	120	165	262	407	127	278	125
longest period ..	3863	3576	6106	6940	5066	9928	4901
mean ..	1044·1	1122·9	2413·0	2218·0	1509·6	2565.9	1457·8
median ..	797·5	1015·0	2218·0	1638·0	1080·0	2181·0	1043·0
s.e. (1) of median.	99·5	113·5	441·0	408·2	394·9	97·0	231·1
Q− ..	434	511	1133	1334	386	974	758
Q+ ..	1580	1400	3182	2801	2355	3318	2186
$\frac{\text{IQR}}{\text{median}}$ % ..	144	88	92	90	182	108	137

Q− = lower quartile ; Q+ = upper quartile.

Neither species stings its prey on the nest or in its vicinity, and we have not seen this performed.

Though the ratio of the sizes of such a larva to an *esuriens* wasp is much greater than that of a spider to a *madraspatanum* wasp, members of the former species introduced their prey much more deftly than members of the latter (Table 7). The larvae were carried by all six tarsi folded in the frontal plane so that both its head and anus were under the wasp's thorax. On landing on or near the cells (and the same wasp may do both on different occasions), the wasp stood on its mid and hind pairs of legs so that the abdomen of the prey was dropped and the head and thorax were carried to the lip of the pot and held there by the tarsi of the fore legs. The larva was then fed into the pot by the mandibles. There was no doubt that the lip of the pot had a function, contrary to the opinion of Fabre (1924). It was used as a landing stage on which to rest the larva while pushing it into the funnel-shaped mouth of the cell. The first few larvae were inserted in under 10 seconds but as the pot filled up the time spent increased until for the last larva several minutes were sometimes spent pushing it in (this is shown up by the coefficients of variation in Table 7). The wasp left immediately she had finished inserting a larva, without the long feeling inside the pot of *madraspatanum*, let alone the entry that suggested that the latter species may rearrange their prey. Eumenes wasps, as has been noted, do not, and cannot, enter their complete pots. In both species, it is while victualling their cells that the greatest number of loadless visits are made. This will be discussed later.

TABLE 7

TIME SPENT *on* NEST WHEN PREY WAS BROUGHT

	*m*1 doubtful prey	*m*1 certain prey	*e*1*	*e*2	*e*5*	*e*8*
no. of timed visits	19	55	10	28	73	58
shortest period	10	11	11	5	6	5
longest period	82	315	90	791	432	107
mean	35·05	55·25	33·50	66·14	40·97	19·14
s.e. of mean	4·38	7·74	28·63	28·91	7·54	2·69
median	31·0	40·25	19·5	21·4	19·75	10·75
$\frac{\text{IQR}}{\text{median}}$ %	74	64	193	180	117	117
C.O.V.%	57·9	104·4	270·2	231·3	157·3	107·0

*longest visit of 531 secs. was an abnormal visit and is excluded for *e*1 ; two abnormal visits of 422 and 633 secs. omitted for *e*5 ; four abnormal visits omitted for *e*8.

The variation in the quantity of prey put into different cells by different individuals of *esuriens* is shown in Table 8. The maximum range shown by any individual was from 3 to 8. A mean of between 5 and 6 in a cell would seem characteristic of the species, though several different species of prey are used, and the coefficient of variation of 31 cells built by 4 mothers is only 20%. If this is compared with Table 3 of Spurway *et al.* (1964), considering the 10 cells of *m*1 in which the coefficient of variation was at least 32% and the number of prey ranged from 3 to 12 or from 5 to 13 according to how doubtful visits are interpreted, this one individual varied more between individual cells in one nest than did five individuals of *esuriens* working during different seasons.

Table 9 shows the condition of the construct when the wasp left it for the night, excluding the night of desertion. The records of nests *e*3, *e*7, *e*9, *e*10, *e*15, *e*16, and *e*19 provide no evidence; *e*11 and *m*5 are omitted because on several days they were not inspected in the evenings. We have included the 6 occasions when a wasp had been painted because, though this usually interrupted the wasp's work for the day, it did not invariably do so. This table shows that out of about 64% (21/33) of the nights that a *madraspatanum* construct was observed, a cell was left completely built but not completely provisioned, whereas the comparable percentage for *esuriens* was about 70% (76/109). Two further points must be noted, firstly only once has an *esuriens* in our sample left a complete cell (*e*8 IV) overnight without an egg, and secondly the egg is present before any provisions are brought. Therefore a cell of *esuriens* almost always has something to offer predators and parasitoids, whereas an unprovisioned cell of *madraspatanum* is an empty cavity containing no animal matter. Therefore it is more meaningful to compare the number of occasions when an unfinished cell was left containing an egg. For the two species this figure is 17/33 and 75/109 or 52% and 69% respectively.

TABLE 8

QUANTITY OF PREY STOCKED BY *E. esuriens*

	*e*1		*e*2		*e*5		*e*8	
	cell	no. of larvae	cell	no. of larvae	cell	no. of larvae	cell	no. of larvae
	II	5	I	5	I	6	I	6*
	III	6	II	5	II	5	II	4
			III	4	III	6	III	6
			IV	7	IV	3	IV	5
			V	7	V	5	V	5
					VI	5	VI	8
					VII	6	VII	7
					VIII	7	VIII	5
					IX	8	IX	6
					X	6	X	6
					XI	6	XI	6**
					XII	7		
					XIII	5		
Mean		5·5		5·6		5·8		5·8
σ2						1·5		1·4
C.O.V. %						22		21
				Mean	5·7			
				Combined σ^2	1·3			
				C.O.V. %	20			

*incomplete ; ** incomplete (1 larva missed by observers).

TABLE 9

	1. CONDITION OF CONSTRUCT WHEN LEFT FOR THE NIGHT							2. NUMBER OF CELLS SEALED PER DAY				
	No. of nights (excluding night of desertion)							No. of days (excluding vaulting and abortive brackets but including day of desertion where relevant) in which wasp sealed				
	Total	cell incomplete	cell open	cell sealed		vaults						
				temp.	perm.	incomplete	complete	0 cell	1 cell	2 cells	3 cells	Total
*e*1	2		2						3			3
*e*2	5		2	●	2	1		2		2		4
*e*4	4		4					2	2	1		5
*e*5	26	1	22(12)		1	1	1	11 (7)	13	1		25(21)
*e*6	2	1			1			2	1			3
*e*8	8		7		1			1	6	2		9
*e*13	3		2		1			1	1	1	1	4
*e*14	6	3	2			1		1	3	2		6
*e*17	1		1					1	1			2
*e*18	3		2		1			2	2			4
*e*20	2		2					1	2			3
*e*21	3		3(1)					3(1)	1			4 (2)
*e*22	18	1	12(7)		4	1		10(6)	7			17(13)
*e*23	14	2	7		5			8 (7)	7			15(14)
*e*24	1	1							2			2
*e*25	11		8(7)		3			7 (6)	4	1		12(11)
Total	109	9	76		19	4	1	52(40)	55	10	1	118(106)
*m*1	13	1	3	6(5)	3			5	9			14
*m*3	8	1	1	6(4)				4(2)	4	1		9(7)
*m*4	12	6(1)		5	1			7(2)	5	1		13(8)
Total	33	8	4	17	4			16(9)	18	2		36(29)

NOTE. The number of cells involved is given within brackets because during periods of rain a cell could remain unsealed for more than one successive night.

However, despite the evidence provided by these figures that it is more frequent for *esuriens* to fail to complete provisioning the day the egg is laid than it is for *madraspatanum*, this former species (and genus) has evolved no equivalent of the concave temporary lid, or curtain (Shafer 1949), with which Sceliphron wasps seal their pots. Sometimes approaching nightfall, or rain, can be seen to provide a stimulus for this temporary sealing, but sometimes no stimulus can be hypothesised. We have seen no temporary lid removed the same day that it was constructed, though we have seen one produce considerable conflict reaction when *m*1 was present exceptionally late in the evening. It is possible that a wasp has no drive to remove this lid except on her first visit of a morning or at least before she has brought a load[1]. If a *madraspatanum* leaves an egg in an unsealed cell overnight, one knows that the nest is deserted. The egg may hatch and develop.

TABLE 10

TIME SPENT *on* NEST WHILE WORKING ON LID

	*m*1		*e*1*	*e*2	*e*5	*e*8
	permanent lid	temporary lid				
no. of timed visits	31	9	2	5	13	10
shortest visit	26	46	44	85	182	50
longest visit	169	244	99	200	427	228
mean	53·94	126·56	71·5	142·6	273·9	111·5
s.e. of mean	6·65	24·08			17·3	15·4
median	38	126		164	261	104·5
s.e. (1) median	6·65	24·08			16·4	14·1
s.e. (2) median	4·73	40·26			19·7	14·9
$\frac{\text{IQR}}{\text{median}}$	92	108			29	49
C.O.V. %	68·7	57·0			22·8	43·8

*working times for two part loads of one lid combined as one observation.

SEALING

The sealing of *esuriens* cells was, as were the other activities, more economical of loads than the previously described actions of *madraspatanum*. Usually, and as we have recorded for *m*1 mud was brought immediately after the last prey was inserted, one of the three exceptions was due to interruption by rain and another may have been due to gathering clouds. This was worked onto the hole also working round the edges inwards, then the lip was bitten round the fragments re-worked into the wet mud already laid down. Kirkpatrick (1957, p. 251) reports that *E. canaliculatus* does not bring mud but only water and the cell is sealed entirely with the material of the lips. Though the next few loads brought by the four *esuriens* watched continuously were daubs, and the first usually was put down on or near the lid region, the attempt to extrapolate from *madraspatanum* and distinguish between lid daubs and cell or construct daubs would be unjustified.

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[1] Wasp *m*4 was seen to pick up from the floor a temporary lid removed from the construct hours before and move it 1·5 cm. while feeling the construct and the floor and wall around it after sealing one cell and prospecting for her next.

As *esuriens*, unlike *madraspatanum*, does not make temporary lids, she has no behaviour pattern for removing them.

Table 10 compares times taken by wasps on the nest during a sealing visit.

(*to be continued*)

Compositae of Raipur and its Surroundings (M. P.)

BY

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A detailed survey of the plants belonging to the family Compositae was carried out during the period 1963 to 1965. As many as 35 species belonging to 28 genera have been collected. Of these 13 species appear to be new records for this area. Field notes, local Chhattisgarhi names where available and economic uses if any are given for each taxon.

INTRODUCTION

The Compositae are distinguished from other families by their characteristic capitulum. Since Raipur is the centre for the Ravishankar University and a number of other Colleges, a detailed survey of the Compositae of Raipur and its neighbourhood was undertaken so that they could be easily identified.

An artificial key has been given by Santapau (1946) based on the floral characters and colour. Venkatesh (1948) published a key to the Compositae of Bangalore, and Govindu (1948) has described the economic importance of Compositae of Bangalore. Ladwa and Patil (1961) studied in detail the Compositae of Dharwar and its vicinity and have given an artificial key based on the ' more obvious and reliable characters '.

LOCATION AND CLIMATE

Raipur city (21° 14′ N. and 81° 39′ E.) is situated at 260 m. above sea level in the Gondwana basin and is the centre of Chhattisgarh. The climate is dry and salubrious. The cold weather begins in November and ends in February. The mean annual rainfall of Raipur is 100 cm., and the rainy season extends from June to October. The absolute maximum and minimum temperatures recorded are 47°C and 4°C. respectively. The Indo-gangetic and peninsular elements exhibit a heterogenous combination in the flora of Raipur.

METHODS

An area of about 16 sq. km. was selected for detailed study. From December 1963 to March 1965 periodical collections were made from the following localities: Shokra nala, Labhandi farm, Budha tal, Doodhadhari tank, Rawanbhata, Ramkund, Dumar tal, Science College surroundings, Sarona and Kharoon river. Plants were studied in detail, identified and later confirmed at the Central National Herbarium, Botanical Survey of India, Calcutta. The herbarium sheets were deposited in the Herbarium of the Botany Department, Govt. College of Science, Raipur. Cultivated and garden plants are not included.

For each species the habitat, locality, flower colour, period of flowering, local name wherever available, economic uses if any and collection number are given.

ENUMERATION OF SPECIES

Ageratum conyzoides Linn.

Very common near margins of tanks and in wet places; corolla white or slightly blue. Flowers all the year round. 56.

Artemisia nilagirica (Clarke) Pamp. *A. vulgaris* auct. non Linn.

A tall aromatic herb; flowers yellow. Flowering during rainy season. 191.

Bidens biternata (Lour.) Merr. & Scherff. *B. pilosa* auct. non Linn.

Only a few plants were observed near Doodhadhari tank; flowers yellow. Flowering: September-December. 169.

Blainvillea acmella (Linn.) Philip.

Very rare, observed near Doodhadhari tank; flowers yellowish white. Flowering: August-November. 47.

Blumea lacera DC.

A common widespread weed during the dry season, growing along road sides, open grounds and rice fields. 45.

Blumea laciniata DC.

Near tank edges and wet places. The plant is silky pubescent with leaves deeply lobed. Flowering: December-April. Local name: *Kukurmutha*. 41.

Blumea mollis (Don) Merr. *B. wightiana* DC.

A weed in wastelands. Heads pale purple. Flowering: February-April. 40.

Blumea oxyodonta DC.

A common weed growing in rice fields and gardens. Involucre pale brown. Flowering : January-May. 44.

Blumea virens DC. *B. membranacea* DC.

Growing only at Shokra nala ; flowers yellowish white. Flowering : January-May. 185.

Caesulia axillaris Roxb.

Common in paddy fields, margins of ponds and tanks ; flowers purple. Flowering: August-April ; Local name : *Bilonda.* 36.

***Centratherum anthelminticum** (Willd.) O. Ktze.

A herb generally found under shade near Doodhadhari tank ; flowers purple. Flowering : September-December. 50.

Cyathocline purpurea (Don) O. Ktze. *C. lyrata* Cass.

Seen growing only at Shokra nala ; flowers rose purple. Flowering : December-April. 42.

Echinops echinatus Roxb.

A spiny thistle-like herb in open dry places in Sarona, Shanti nagar, Science College surroundings and Shokra nala. Flowering : December-May. Local name : *Utkutal.* 54.

Eclipta prostrata Linn. *E. alba* Hassk.

A tall herb along margins of ponds and wet places. Some plants reach a height of 90 cm. with peduncles up to 5 cm. long, thus differing from the report by Haines. Flowers all the year round. Local name : *Bhingra.* 153.

Elephantopus scaber Linn.

Not so common, generally found under shade in Dumar tal area, Sarona and Shokra nala ; corolla purple. Flowering : August-November. 49.

Emilia sonchifolia (Linn.) DC.

A common weed in gardens and cultivated lands ; flowers pink. Flowering : July-April. 48.

Enhydra fluctuans Lour.

Only found growing along the margin of Doodhadhari tank, cultivated on a large scale and used as a vegetable. Flowering : February-April. Local name : *Jogni.* 46.

***Glossocardia linearifolia** Cass.

A small herb with pinnatisect leaves ; heads yellow. Flowering : September-November. *Harirachara*, 187.

Glossogyne pinnatifida DC.

A perennial glabrous herb with radical leaves seen in the Science College surroundings. Flowering : February-November. 58.

Gnaphalium indicum Linn.

Abundant along margins of tanks, ponds and ditches ; flowers silky white. Flowering : December-April. Local name : *Chitavar*, *Rui*. 38.

Gnaphalium luteo-album Linn.

A woolly herb. Heads corymbose, brown, whitish or golden yellow, common near river banks and wet places. Flowering : February-April. 188.

Goniocaulon glabrum Cass.

An erect annual. Heads purplish rose. The leaves used as a vegetable. Collected from Durg Road, Sarona and Sambalpur Road. Flowering : January-April. Local name : *Barra bhaji*. 59.

Grangea maderaspatana Linn. Poir.

A common weed of open grounds and rice fields. Heads pale brown when young later becoming yellow. Flowering : December-April. 33.

***Lagascea mollis** Cav.

A weed of open wastelands ; flowers white. Flowering throughout the year. 167.

Launea nudicaulis Hook. f.

Seen only in the Science College Campus. Flowers yellow. Flowering : January-April. 60.

Pulicaria angustifolia DC.

A common weed of open dry lands on red gravelly soil ; flowers yellow. Flowering : September-May. 35.

***Pulicaria foliolosa** DC.

Not so common but occurs in wet places and near ponds at Sarona and Durg Road. Flowering : February-April. 155.

Sphaeranthus indicus Linn.

Abundant in rice fields and along margins of tanks ; flowers reddish purple. Flowering : November-May. Local name ; *Gudariya*.

Sonchus brachyotus DC. *S. arvensis* auct. non Linn.

A common weed in waste lands and cultivated fields ; flowers yellow. Flowering : August-April. Local name : *Ut Kutar*. 55.

* **Sonchus oleraceus** Linn.

Seen as a weed only in the botanical garden, Science College ; flowers yellow. Flowering : February-April. 53.

Tridax procumbens Linn.

Common herb of waste lands, open places ; buds brown, flowers yellow. Flowering throughout the year. 43.

Vernonia cinerea Less.

A common weed inhabiting newly exposed soil ; heads 0·6 cm. long purple or white. Flowering throughout the year. 51.

Vicoa indica (Willd.) DC. *V. auriculata* Cass.

Common near Science College. Heads yellow in panicles. Flowering: November-May. 34.

Volutarella divaricata Benth.

A spreading spinous herb grows luxuriantly after the harvest in paddy fields. Flowering : January-April. Local name : *Gukuru*. 57.

Xanthium strumarium Linn.

Found on river banks along Kharoon River and Shokra nala. Flowering : December-January. Local name : *Kothwa*, *Latkana*. 37.

DISCUSSION

Haines (1925) reports 22 species of Compositae belonging to 19 genera in Chota Nagpur while Duthie (1903) mentions only 6 species. In the present account 13 species are new records for this region. Haines has not recorded species of *Bidens*, *Caesulia*, *Cyathocline*, *Goniocaulon*, *Lagascea*, *Launea*, *Pulicaria* and *Volutarella* from Chota Nagpur which includes a part of Chhattisgarh.

ACKNOWLEDGEMENT

The author is grateful to Professor R. C. Agnihotri and Dr. V. B. Sharma for encouragement, Dr. R. P. Mathur for facilities and Dr. K. Subramanyam for kindly going through the manuscript.

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* Reported for the first time from this region.

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The Management of India's Wild Life Sanctuaries and National Parks

BY

E. P. GEE, M.A., C.M.Z.S.

PART V

[*Continued from Vol.* **59**(2) : 485]

APPENDIX

The following resolutions on wild life sanctuaries and national parks have been passed by the Indian Board for Wild Life and its Executive or Standing Committee between 1963 and 1965, and are a continuation of those published by me between pages 458-463 in Part IV of this paper [*J. Bombay nat. Hist. Soc.* **59** (2), (1962)].

RECOMMENDATIONS OF THE INDIAN BOARD FOR WILD LIFE ON WILD LIFE SANCTUARIES

' The Board reiterated the necessity of using the correct terminology in respect of wild life preservation, and recommended that all sanctuaries should be referred to as " wild life sanctuaries " and not as " game sanctuaries ".

' The Board stressed that in view of the shrinking habitat of wild life due to various inroads into the forest areas, a larger number of sanctuaries and national parks should be established.

' The Board recommended that as far as possible grazing of domestic animals in sanctuaries should be prohibited.

' The Board strongly expressed itself against the violation of the sanctity of national parks and sanctuaries by permitting shooting therein by foreign dignitaries and V.I.Ps. The Board recommended that the prohibition of shooting in national parks and sanctuaries and the prohibition of shooting protected species should apply equally and without distinction to all, including foreign dignitaries and V.I.Ps.

' The Board gave careful consideration to the note forwarded .... suggesting that the tourists' facilities inside national parks and sanctuaries should be under the control of the Department of Tourism. While recognising the position of national parks and sanctuaries as places of special tourist attraction, the Board pointed out that their primary function was to ensure the undisturbed existence of the wild life in them. To ensure proper co-ordination in the provision of necessary facilities to the tourists desirous of visiting national parks and sanctuaries, the Board recommended that it was necessary to place the control of tourists' facilities also in the hands of the Forest Departments which were the authorities in charge of the sanctuaries. The Board also observed that the main interest of the tourists was to see wild life in their natural habitat, and the best facilities for this purpose could be given by the sanctuary authorities themselves rather than by any outside agency. The Board, therefore, did not favour dual control on tourist facilities in national parks and sanctuaries.'

[Sixth Session, Dhikala (Corbett National Park) 1965]

' This meeting endorses the various resolutions and recommendations made at the First World Conference on National Parks held at Seattle, Washington, from June 30th to July 7th, 1962, in so far as they apply to India, and draws attention in particular to *Recommendation No.* 3 which says *inter alia* that " there is an urgent need to constitute on a world scale a systematic collection of type habitats as varied and representative as possible which could be permanently protected and to serve as standards for the future, and . . . . that the appropriate status for these type habitats where possible should be that of strict nature reserves".

' This meeting endorses the recommendations made at the Project Mar Conference which took place from 12th to 17th November, 1962, in France, which was sponsored by the I.U.C.N., the I.C.B.P. and the I.W.F.R.B., in so far as they apply to India, and draws attention particularly to Recommendation II which says *inter alia* " Whereas wetlands by their natural biological productivity and by their educational, scientific, cultural, economic and recreational values constitute habitats of the greatest importance and interest to humanity and WHEREAS as a result of drainage, industrialization and other changes in land-use these regions are becoming scarcer . . . . the Mar Conference RECOMMENDS that Governments make provision for wetland reserves in all national and regional development plans ".'

(Special Meeting of Standing Committee held with I.U.C.N. Delegation, New Delhi, 1965)

RECOMMENDATIONS OF THE INDIAN BOARD FOR WILD LIFE ON NATIONAL PARKS

' The National Parks Policy and the Standards of National Parks in India submitted for the approval of the Board were generally approved and adopted.

'The following national parks already in existence have the approval of the Indian Board for Wild Life to remain as such :

(1) Corbett National Park in Uttar Pradesh
(2) Kanha National Park in Madhya Pradesh
(3) Shivpuri National Park in Madhya Pradesh
(4) Hazaribagh National Park in Bihar

'The Board approved that the following wild life sanctuaries may now be upgraded into national parks by legislation to be enacted in the various States :

(1) Manas	Assam
(2) Kaziranga	,,
(3) Jaldapara	West Bengal
(4) Periyar	Kerala
(5)[1] Bharatpur	Rajasthan
(6) Jaisamand	,,
(7) Sariska	,,
(8)[2] Taroba	Maharashtra
(9) Bandipur	Mysore
(10) Mudumalai	Madras
(11)[3] Gir	Gujarat (not yet declared a sanctuary)

'Other areas which may have been called national parks of State significance may be appropriately re-named in order that the standards of national parks may be maintained.'

(Fifth Session, Mysore, 1963)

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[1] It was later considered whether Bharatpur should be omitted from this list, because of the shooting rights belonging to the Maharaja there.

[2] It was later found that Taroba is already being called a national park.

[3] The Gir Forest was constituted as a national park in 1966.

Obituary

G. V. R. FREND

It is with deep regret that the death of Mr. G. V. R. Frend is recorded. He died at Chikmagalur on the 27th September 1966 at the age of 68.

He came to India in 1915 and was one of the pioneers of coffee planting. A keen naturalist and sportsman, he was a good shot, mainly interested in small and feather game. He was also a keen fisherman. Mr. Frend often contributed articles for the Society's *Journal* and was always very helpful for any information and assistance on matters of Natural History. He joined the Society in 1923 and was a life member. Retiring from active planting life in 1959, he settled at Chikmagalur. He kept his interest in Nature study alive to the end in spite of his failing health.

Mr. Frend will be missed by all who knew him. He was an extremely generous person and was always willing to help anyone who asked him for aid.

On behalf of the Society our deepest sympathy goes out to his two sisters and other relatives in England.

K. R. S.

Reviews

1. WORLD BENEATH THE OCEANS. By T. F. Gaskell. pp. 154 (27 × 19·5 cm.). With numerous colour drawings, photographs and maps. London, 1964. Aldus Books Limited. Price 32*s.* 6*d.*

One of the four books in the Modern Knowledge Series of the publishers, this book provides simple and authentic reading on aspects of the Oceans not only for the general public, but also to the students of secondary and middle schools.

The colour drawings and photographs illustrating the fascinating aspects of the wonderful and varied world beneath the sea are excellent. Within its 150 pages are included almost all aspects of the sea, its movements such as tides and currents, the shape of the sea floor, the sediments and their origin, the rocks beneath the sediments, minerals of the sea, the great chain of life in the sea and finally how the science of Oceanography is helping to shape the future exploitation of marine resources of food, oil deposits and other minerals.

At the end of the book there is an exciting chapter on the future of Oceanography and its impact on mankind. Some of the projects such as the Allantropa Project proposed by the German Architect Herman Sorgel in 1928 would, if completed, convert the Mediterranean Sea into a vast lake by damming the Straits of Gibraltar and the Dardenelles. As a result of these dams there would be a drop of 33 feet every ten years in the sea's water level due to evaporation providing steep gradients and a source of abundant hydroelectric power at the mouths of rivers flowing into the Mediterranean. Besides the exposed coastal areas would extend the limits of some of the bordering countries, thus providing more land for human use.

Similar proposals, to dam the Bering Straits and thus cut off the Arctic Ocean from the Pacific, would create warmer conditions in the arctic and open the frigid coasts of Northern Canada and Siberia for shipping traffic.

Both the publishers and the author deserve commendation for bringing out a fine book which could well be translated into our Indian languages for wider circulation to keep pace with the growing demand in the country for information.

T. S. S. Rao

2. HOW WE GOT OUR FLOWERS. By A. W. Anderson. pp. 283 (21·5×14 cm.). Illustrated by Alex Jardine and E. Sears. New York, 1966. Dover Publications Inc. Paperbound. Price $1·75.

A. W. Anderson's HOW WE GOT OUR FLOWERS, originally published by Williams and Norgate Ltd. in 1950 under the title THE COMING OF FLOWERS, reappears, with the text unchanged, in the form of a stout paperback evidently designed to stand frequent handling for purposes of reference—a form of use that is now facilitated by the addition of an index.

In this small book the author talks in general terms about a large number of plants, saying something perhaps about the plant itself, or the country of its origin, or an interesting fact connected with the plant or with its introduction to cultivation. Many of the plants will be strange to the ordinary reader in this country, but he will find much to interest him nevertheless.

The hunt for new plants in strange lands is a hazardous occupation; several collectors lost their lives but there does not seem to have been any difficulty in finding new candidates. Jeanne Baret, accompanying Louis de Bougainville after whom the genus *Bougainvillea* is named, ran an unusual risk. Tempted by the adventure she joined the expedition disguised as a man and narrowly escaped from being kidnapped by a Tahitian chief, who was the first person to penetrate her disguise. Unusual, also, was the fate of Taukata who brought the Sweet Potato, *Ipomoea batatas*, to New Zealand and paid for it with his life as the Maoris decided that only his blood could prevent the life-principle of this valuable plant from returning to its warm Pacific home. One must draw the line however at Benedict Roezl, said to have been robbed no fewer than seventeen times and to have had his life spared on one occasion because the leading robber was afraid of offending the Gods since a plant-hunter must necessarily be mad and therefore under their special protection! In line with these adventures is his account of an experience at Colombo, when a jaguar (*sic*) entered his tent while he was working at his notes, calmly explored the tent, and ended up by rubbing itself against his table purring like a domestic tabby the while!

The lure of gain or fame sometimes led to mean acts. For instance, a collector taking *Cypripedium spicerianum* from Assam exterminated the orchid in the locality where it was found so as to send up the price in his intended market in Europe. But on the other side there were acts of generosity, as when Sir Joseph Banks, presented with Labillardière's collection from Australia and Tasmania taken as prize of war, refused to 'deprive the man who, at the risk of his life, had gone forth to win them, of a single botanical idea', and saw that the collection was returned to Labillardière. And during a war between Britain and France, when Empress Josephine was stocking her garden at Malmaison with plants from England, the British Admiralty instructed its officers of the fleet to forward to the Empress seeds and plants addressed to her and seized as enemy prize.

It is interesting to note the different values that once attached to some plants now prized for their flowers. Dr. Andreas Dahl thought of the tubers of his namesake the Dahlia as a possible substitute for the potato, lilies were first grown for their real or supposed medicinal value, and cannas were sent home from the New World by the Spanish missionaries to provide rosary beads!

Among the historic trees mentioned is a Weeping Willow planted by the poet Alexander Pope in his garden at Twickenham. A twig from this tree taken to America is believed to be the ancestor of most of the Weeping Willows growing in the United States, and another twig planted on St. Helena is associated with Napoleon during his years of exile on that island. According to some people Pope's tree was finally destroyed by a subsequent owner, who resented having to show it to visitors—a story also related about a Black Mulberry tree at Stratford-on-Avon the planting of which is attributed to Shakespeare.

This is a book well worth reading, but it must be remembered that it does not pretend to be an encyclopaedia.

D. E. R.

3. SPORTING JOURNEYS. By Philip K. Crowe. pp. xii+183 (22·8×15·4 cm.). With 16 monochrome plates. Barre, Massachusetts, 1966. Barre Publishers. Price $ 7·50.

While he was America's Ambassador to Ceylon from 1953 to 1956 and to the Union of South Africa from 1959 to 1961, the author had many opportunities of visiting the countryside and indulging in his favourite pastimes of fishing and shooting. With an obvious flair for grasping the salient facts about places and for vividly describing them, he takes us on fishing and shooting expeditions in Ceylon, south India, the old princely State of Indore, and Kashmir before travelling round South Africa.

Although this kind of *shikar* book may be considered by many to be now out of date, one cannot fail to be struck by the fact that only limited bags and warrantable heads are obtained in the best traditions of *bona fide* sportsmanship. As the author remarks, his 'interest was also in conservation and none of the animals killed were on the danger list of vanishing species. Legitimate hunting under license is, in fact, to the great advantage of conservation, for without the revenues derived from hunting parties, there would be virtually no funds available for game wardens. Legal shooting is one of the least important reasons for the decline in the world's wildlife.'

In the portion of the book dealing with India, the narrative (apart from a few misspelt names of persons) is interestingly and accurately done—making the book a most readable one. A keen appreciation of the beauties of nature is always evident: in fact it is as a conservationist that the author will eventually be remembered, for after retiring from his official diplomatic career he has become a roving ambassador for wild life conservation and has visited the Near East, Africa, South America, Australia, and Asia including India, on behalf of the World Wildlife Fund—of which he is a Director.

The reviewer had the opportunity of accompanying the author to Kaziranga and Manas Sanctuaries in Assam, and to Sikkim, in March 1966, and eagerly awaits future books on the regions of the world traversed by this able writer with the certain knowledge that the cause of wild life conservation will be furthered.

E. P. G.

4. AFRICA : A NATURAL HISTORY. By Leslie Brown. pp. 299 (32×25 cm.). With 249 illustrations including 103 in colour. London 1965. Hamish Hamilton Ltd. Price 5 *gns.* net.

In any company, this is one of those books which cry out to be picked up and looked at. Nor does it disappoint, for with a wealth of information and some really magnificent photographs in both monochrome and colour, it lives right up to its first inviting promise.

To collect the material for AFRICA took its author Leslie Brown some 25 years, a period during which he was serving as an agricultural officer first in Nigeria and then in Kenya. He has also travelled very widely across the length and breadth of Africa and is not only an ecologist but a highly trained and observant zoologist as well.

That any single book on a continent as vast as Africa can ever be 'little better than a vignette' is a fairly obvious truth, but just how profound this truth actually is only really emerges when some facts and figures come to light. A land-mass 11,699,000 square miles in extent. A complexity of climate and terrain which varies from the biting cold of snow-clad mountain peaks to the furnace of El Azizia in the Sahara, the hottest place on earth and where an incredible 170° F. on the surface and 136·4° in the shade have been recorded. In between, literally everything else. Temperate and sunny highlands, glorious sweeps of fertile plains and great swamps, and a maze of mighty rivers and mountain ranges. Unique is the Great Rift Valley. There are too, vast savannas and woodlands, the semi-arid zones of the Sudan, and the equatorial forests of the Congo, tangled and steamy and the haunt of much fantastic and contrasting wildlife from the tiny Duiker antelope no bigger than a hare to the hulking great gorilla.

There is certainly nothing 'dark' about this continent here, all this unfolds in a blaze of brilliant photographs, and, except perhaps for a few unfortunates either blind or too preoccupied to be interested in a single aspect of nature's wonders, there must surely be something in this book for everyone, be it birds or reptiles or animals or some of the absorbing and curious information. Much of it is indeed curious and with not a few facts that would have delighted Believe-It-or-Not Ripley. Do birds migrating from Europe fly straight across the Sahara? According to Leslie Brown, who is also a well known ornithologist, only a few come down at the scattered oases to feed and rest while all the rest, hundreds of millions annually, make the flight in a single hop and at heights up to ten thousand feet. For the tiny willow warbler, this means that it must fly non-stop for some sixty hours across a thousand miles of burning sand without a drop of water which must surely be a feat of endurance hardly if ever rivalled by any other living thing.

The photographs of animals are truly splendid. Elephants, the rhino and the hippo, giraffes and the buffalo, the rare mountain nyala and that improbable-looking creature the aadvark. Nearly every African animal must be here, both large and small, and, with authority and a remarkable simplicity, the author describes them all, their habits and their peculiarities.

There is, though, one rather glaring omission. There is not a single picture anywhere in the book of the most dangerous and by far the most destructive animal of all. That there may in fact be a reason for this omission does not at once strike home, but from what at times peeps through Leslie Brown's admirable restraint when describing the activities past and present of the animal he calls 'Man the Destroyer', the absence in a beautiful book like this of any pictorial reminder of the culprit himself or of any of his works becomes not only an omission to be loudly applauded but one that may well be both calculated and deliberate.

To many it will perhaps seem hardly possible that the vast herds of game which roam this continent could ever really be reduced to any dangerous level by mere man alone. Aren't there game laws and people to enforce them? There are indeed. but there are too 'meat-hungry Africans' and, with little doubt, there will also be a healthy proportion of their 'other' counterparts as well. Could this be another sadly familiar story? The one about official indifference and of officials and others shooting illegally and with complete impunity whenever they wish? Leslie Brown does not say so, but he obviously is very far from happy about the future of African game.

Hugh Allen

5. THE GREAT BARRIER REEF. By Eric Worrell. pp. 128 (28×22 cm.). Numerous photographs, monochrome and in colour. Sydney/London/Melbourne, 1966. Angus and Robertson. Price 45*s*./$ 4·50.

THE GREAT BARRIER REEF is addressed to the numerous holiday makers and tourists resorting to the north-eastern coast of Queensland, drawn there by its equable climate, its many beaches, and the attractions of the Great Barrier Reef opposite. The well illustrated text is primarily intended to provide visitors with a superior kind of guide book but, one of the major attractions being the local fauna, we get several pictures and notes of natural history interest. There are good pictures of corals, fish, and other underwater fauna, many of them in colour; and some pictures which give a good idea of the vegetation.

In a short chapter towards the end on 'Life in the Jungle' the author mentions an interesting observation about the Scrub Python (*Liasis amethystinus*). At the edge of the rain forest in North Queensland, he says, the Scrub Pythons crawl into the branches of the fig trees and gorge themselves on roosting flying foxes, the other flying foxes meanwhile carrying on with their preening or suckling of their young, apparently unmoved by the fate of their companions.

One picture shows a number of starfish with numerous arms lying on the beach—a close-up of a single one shows that the name, Crown of Thorns, is well deserved. The caption informs us briefly: 'The Crown of Thorns (*Acanthaster planci*) are brought up from the reef by skin-divers and, when dead, thrown back into the sea'. The cruel and seemingly meaningless behaviour is explained in the text. The Crown of Thorns is proving a menace to the coral reef. It has increased in numbers, and has been sucking the live polyps off the hard coral skeletons. Extensive areas of the reef have been destroyed, and the authorities are busily studying its biology in search of an effective means of control. In the meantime, skin-divers are paid a bounty per Crown of Thorns destroyed.

D. E. R.

6. AUSTRALIAN WILDLIFE. By Eric Worrell. pp. 128 (28×22 cm.). Numerous photographs, monochrome and in colour. Sydney/London/Melbourne, 1966. Angus and Robertson. Price 45*s.*/$ 4·50.

AUSTRALIAN WILDLIFE tells its tale by means of annotated photographs, most of them monochrome, a few in colour. In a little over 200 illustrations it gives a rapid survey of the birds, mammals, reptiles, and plants of Australia and New Guinea. With the wide variety of animal and vegetable forms available to the author, many of them peculiar to this region, such a collection cannot fail to be interesting; particularly so is the section on reptiles with its series of lizards, including the 15-foot Salvador's Monitor (*Varanus salvadori*) from Papua, and 27 coloured pictures of frogs. Tucked in among the pictures of snakes is a photograph of George Cann, snake-charming wizard, sitting comfortably with a newly captured bunch of deadly tiger-snakes (*Notechis scutatus*) before him which he apparently handles unaided and keeps together with his bare hands, exploding the myth that it is only Indian snake-charmers who can do such things. A picture of the well known Kookaburra (*Dacelo gigas*) hides on the last page of the index, and an intriguing picture of a young Whip Bird (*Psophodes olivaceus*), about which we are told nothing, appears rather wastefully on the dust jacket. At times the captions to the pictures are tantalizingly short. We would like to know, for instance, how 'native' women were used to attract Tasmanian Fur Seals (*Gypsophoca tasmanica*).

And the Mallee Fowl (*Leipoa ocellata*) cockbird deserves some description of the great skill and labour with which he maintains the correct temperature in the nesting mound throughout the 5 to 6 months and more occupied by the laying of the eggs and the hatching out of the young. So, also, we would expect some mention of the amazing instinct which guides the young Mutton Birds (*Puffinus tenuirostris*), deserted by their parents when they are about three months old, from the Bass Strait breeding grounds, south of Australia, to the wintering area in the Bering Sea, far north of Japan.

D. E. R.

7. ANIMAL BEHAVIOUR. By J. D. Carthy. pp. 156 (27× 19·5 cm.) 30 coloured and 105 black and white plates. 28 Illustrations. London 1965. Aldus Books Pvt. Ltd. Price 32*s*. 6*d*. net.

As a lecturer of Zoology as well as a person carrying out advanced research in Animal Behaviour Dr. Carthy is one of the most competent authors among present-day biologists for writing a popular book on behaviour. His latest book on the subject helps to bridge the tremendous gap which exists between popular concepts and recent advances in objective studies of behaviour.

The author defines behaviour as the response of an organism to its environment, i.e., response to physical chemical or emotional stimuli. The effective stimulus varies from one animal to another and also in the same animal depending on its physiologic factors, such as circulating hormones, amount of sugar in blood, etc. The causes that make one pattern of behaviour switch off and another set of responses come into play are not yet known.

Instinctive patterns of behaviour are those which are not learned and are not dependent on or modified by experience. Instinct works in 3 phases: (1) Motivational factors like hunger provide the urge and the animal behaves appetitively. (2) In this second phase it searches for the right conditions in which to satisfy the drive. (3) When it reaches the right stimulus (or a particular releaser) the instinctive act is released. A specific stimulus (or a group of stimuli) that elicits instinctive behaviour is a releaser. Animals can be tricked to respond to supernormal stimuli as were the Herring Gulls which tried to 'retrieve' the larger imitation eggs. Each animal is born with a capacity to respond to a particular type of releaser, but the precision of response varies between individuals and can be modified as during a critical stage in early infancy.

If the drive for a particular instinctive behaviour crosses a threshold before the releaser is available the instinctive act may be performed *in vacuo.* If the releaser is available and still the animal is not somehow able to complete the correct behaviour pattern the energy may be displaced to an altogether different activity. Behaviour of an adult animal thus shows derived as well as displaced elements which arise as a side effect of physiologic events taking place within its body.

Not all animal behaviour can be triggered off by external releasers; the animal can anticipate the signal of the physical environment. These cyclic activities are timed by 'physiological clocks'. Many of these cyclic events in animal life, like activity and rest are regulated solely by the regular alteration of daylight and darkness, or have a 24 hour periodicity. Such physiologic clocks can be detected by suitable experiments on laboratory animals. Rhythms geared to the length of the year bring birds into reproductive conditions. Successful completion of avian breeding cycle depends on a number of internal and environmental factors. Other aspects like 'home-ground', bringing up of young, intelligence, learning etc. are also discussed.

This very satisfying book thus covers nearly all aspects of animal behaviour indicating both the methods of study and limitations of knowledge in clear non-technical language. The basic physiology of some of the sense organs is explained with suitable illustrations.

Mention could have been made of the critique of the instinct theory Lehrman (1953). For instance the theory involves preconceived and rigid ideas of innateness and which obscures the necessity of investigating the underlying mechanism. The definition of habituation as learning *not* to behave is rather confusing. No nature-lover who takes behaviour study seriously should miss this book. This is particularly valuable for Indian Biology students who do not study Behaviour as a subject at the Graduate level.

D. N. M.

Miscellaneous Notes

1. A NOTE ON THE OCCURRENCE OF THE MALAYAN SUN BEAR *HELARCTOS MALAYANUS* (RAFFLES) WITHIN INDIAN LIMITS

(*With a plate*)

The Malayan Sun Bear *Helarctos malayanus* (Raffles) 1822, is well known to those who have resided or worked for a number of years in north-east India as occurring in the hills south of the Brahmaputra and up to the Burma border. Sterndale (1929) describes its habitat as 'Garo Hills east and south to the Malay Peninsula, Sumatra, and Borneo'. The Garo Hills are, of course, the westernmost hill district of Assam, and 'east and south' from there would include the Khasi and Jaintia Hills, Mikir and North Cachar Hills, Nagaland, Manipur and Mizo (formerly Lushai) Hills.

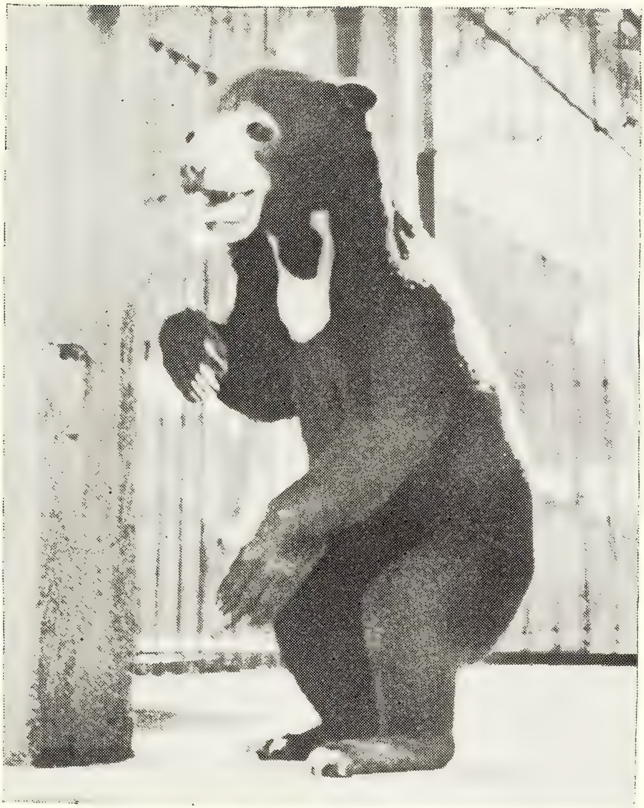
Lydekker (1924) states that 'the range of this bear extends from the islands of Java, Sumatra . . . and the Garo Hills'. He also mentions that 'a mounted specimen in the British Museum is from Assam; it stands 24 inches in height at the shoulder, and measures 52 inches in length (head and body)'.

Tate Regan includes the Malayan Sun Bear in his book NATURAL HISTORY, of which the mammalia section was apparently done by R. I. Pocock. In this book this bear 'ranges from Assam, through the Malay countries to Borneo'.

Higgins (1932) recorded one of these bears shot by a sepoy in Manipur State, about longitude 93·25′ and latitude 25·7′. A photograph of this Malayan Bear was published in the Society's *Journal* of that year [Vol. **35** (3): 673]. Higgins goes on to say that 'this bear is distributed throughout the hills of the (Manipur) State, but is not common . . . During the three years I was in Nowgong (Assam), which is slightly further west than the Manipur State, I only came across one Malay Bear. Some Mikirs brought in what they claimed to be a "black tiger", for the reward. This proved to be a full-grown Malay Bear'. Nowgong, of course, is situated at the foot of the Mikir Hills, which are part of the range of this bear.

Again Higgins (1934) in a monograph entitled 'Game Birds and Animals of Manipur' published in the Society's *Journal* states that the Bruan or Malay Bear (Manipuri name *sāwom*) occurs in the hills but is rare.

Gee : Malayan Bear



Malayan Sun Bear from Mizo Hills in Gauhati Zoo, November, 1966

(*Photo : Brian Bertram*)

Now for my own personal experiences of the Malayan Sun Bear in Assam. In the year 1937, while I was manager of Bonn Tea Estate, a friend who lived and worked at Methoni Tea Estate situated between Kaziranga Sanctuary and the Mikir Hills, brought me a young sun bear which he had been given by the local villagers. A few days later I heard that another baby sun bear had been brought to another planter friend on Behora T.E.—which is also situated at the foot of the Mikir Hills, a few miles to the east of Kaziranga. I made enquiries and acquired this bear also, so that I now had two—in fact a pair because they were of different sexes. I have found an old faded photograph, which might be possible to reproduce with this Note, of the two youngsters being fed. They were chocolate brown with a golden yellow U on their chests.

They were very tame, but as they grew up they became somewhat of a handful, so I offered them as a gift to the Alipore Zoological Garden, Calcutta. The then Honorary Secretary, Mr. H. A. Fooks, gratefully accepted them. The following year, 1938, as I passed through Calcutta *en route* to Britain on home leave I called in at the Zoo, and I remember Mr. Fooks purchasing a tin of golden syrup and we enjoyed watching (and hearing) the two bears gulping it down.

Recently in 1966 I was strolling round the Gauhati Zoo and instantly recognised a Malayan Sun Bear in one of the enclosures. It was a female. I was then accompanied by Mr. Brian Bertram, the Cambridge University Zoology Research Scholar, and as I had to return to Shillong I asked him to find out the details of this bear and where it came from. Apparently Mr. K. K. Gogoi, Director of Inland Water Transport in Gauhati, collected the bear from the Mizo Hills, from the village of Kangphui, forty miles north of Aijal; and the local people told him that the mother and two other cubs had escaped, and that this kind of bear is quite common there, more so than the Himalayan Black Bear. They also said that it is more easily domesticated and makes quite a good pet, and that it is more arboreal and produces its cubs in a hole in a tree.

Mr. Gogoi quoted another instance of the Malayan Sun Bear being found in the Mizo Hills: a member of the Defence Services shot a mother Sun Bear when she charged him. There were cubs.

Shortly afterwards I heard that there was a Malayan Sun Bear in the Trivandrum Zoo, and that it had come from north-east India. So I wrote to the Director, Mr. K. P. Pillai. His reply dated 5-12-1966 confirmed that the bear is indeed a Malayan Sun Bear and that 'this animal was presented to the Zoo, sometime during 1964 by the officers of the Madras Regiment who had picked up from within

Indian territory, near North-Eastern borders'. He is still trying to obtain more information. It is possible that this is one of the cubs of the mother bear reported in the previous paragraph to have been shot in the Mizo Hills by Defence Personnel.

A planter friend of mine with a lot of experience in Cachar District, Mr. Oliver Caruthers, informs me that the Malayan Sun Bear has been observed by many planters on tea estates of that district where it borders near the foothills of the Mizo Hills. He has seen at least two personally, one in the wild and one kept in captivity by a neighbouring planter.

When Mr. Juan Spillett was working at Kaziranga in March and June 1966, he says he heard several reports of the Malayan Sun Bear being found in the vicinity, and so included it among the species to be found there. I also informed him that it was from that same locality that I had successfully reared two young ones in 1937.

Surprisingly enough there is no mention of this interesting bear in Prater's BOOK OF INDIAN ANIMALS; and in Ellerman and Morrison-Scott's CHECKLIST OF PALAEARCTIC AND INDIAN MAMMALS it is not recorded as occurring in India.

But from the foregoing it is abundantly clear that the range within Indian limits of the Malayan Sun Bear should be given as 'Hills south of the Brahmaputra River in Assam extending southwards to Manipur and the Mizo Hills'; or simply as 'Hills of north-east India south of the Brahmaputra River'.

EVERGREEN COTTAGE,
UPPER SHILLONG 5,
ASSAM,
April 1, 1967.

E. P. GEE

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2. NOTES ON THE TAXONOMY AND DISTRIBUTION OF THE PACHMARHI HARE, *LEPUS NIGRICOLLIS MAHADEVA* WROUGHTON & RYLEY [MAMMALIA : LAGOMORPHA : LEPORIDAE]

The Pachmarhi Hare, *Lepus nigricollis mahadeva* Wroughton & Ryley is said to be an aberrant form with a restricted distribution, occurring only in Mahadeo Hills, Hoshangabad and Balaghat districts, Madhya Pradesh (Wroughton & Ryley 1913 a: 15; 1913 b: 57). Two other subspecies of the species, namely *simcoxi* Wroughton and *ruficaudatus* Geoffroy also occur in Madhya Pradesh; the former in 'Nimar, Berar and Central Provinces' (Ellerman & Morrison-Scott 1951: 438), in south Madhya Pradesh, and the latter in 'Gwalior, . . . Central India' (Ellerman & Morrison-Scott, loc. cit.: 438), in the north of the State.

A small collection of mammals made in Shahdol District, Madhya Pradesh, by Shri H. Khajuria of this Department, in May 1962, and recently received here, includes two specimens of *mahadeva* taken at Amarkantak, a place much outside the known range of this subspecies. Furthermore, an earlier collection of mammals from Balaghat District made by Dr. B. Biswas in August-September 1957, also includes four examples of *mahadeva.* Since, neither the description of the external characters of this form, nor its distribution fully correspond to the earlier works on the subject (Wroughton & Ryley 1913 a: 15), it has been thought worthwhile to record my findings in the following pages. Opportunity has also been taken to redefine the ranges of these three subspecies occurring in Madhya Pradesh, and to provide a working key for their identification on the basis of external characters.

Measurements: All measurements are in millimetres and of adult specimens. The external measurements were taken by the collector in the field. The cranial measurements are after Ellerman (1947) except for the greatest length which was taken from the anterior tip of premaxilla to the hindermost point of occiput.

Lepus nigricollis mahadeva Wroughton & Ryley

Lepus mahadeva Wroughton & Ryley, 1913. *J. Bombay nat. Hist. Soc.* **22** : 15.

MATERIAL

2 ♂♂ (1 juv.), 1♀ ; Muki (*c.* 549-686 m. alt.), Banjar Valley, Balaghat District, Madhya Pradesh, 2, 17 and 21 September, 1957. 1 ♂ ; Supkhar (*c.* 555 m. alt.,)

Banjar Valley, Balaghat District, Madhya Pradesh, 26 September, 1957 ; Collector : B. Biswas. 2 unsexed; Amarkantak (*c.* 1065 m. alt.), Shahdol District, Madhya Pradesh, 15 and 19 May, 1962 ; Collector : H. Khajuria.

Measurements

External :	2♂♂	1♀
Head and body	467,477	650
Tail	70, 87	95
Hind foot	105,106	105
Ear	94,95	99

Skull :	2♂♂	1♀	2 unsexed.
Greatest length	96, 97	94·7	86·5, 95
Condylobasal length	85, 85·1	83·1	77, 83·3
Occipitonasal length	..	..	87·5, 93·9
Zygomatic width	83, 85·1	40·2	40·7, ..
Nasal length	42, 42·5	41	36·7, 39·3
Palatal foramen	23·7, 24·7	24·5	20·8, 23·8
Upper tooth row	15·9, 17	16·5	15·2, 16·6
Diastema	24·5, 25·6	26·5	24, 25·3

Coloration: General coloration of the body agrees well with the description of Wroughton & Ryley (1913). However, except the female example from Muki, the nape in the other specimens have, in addition to grey, a little buffy suffusion, particularly on the middle of the nape along the vertebral column, due to intermixture of some buff-tipped hairs. This is more pronounced in the specimens from Amarkantak. Also, these specimens differ a little from those of Muki and Supkhar in having lesser amount of black on the basal parts of the tail hairs dorsally. The female example from Muki possesses an unusual patch of white hairs on the back close to the tail.

Distribution: Lepus n. mahadeva is a poorly known form, and the only previous record is based on six specimens of the type-series from Mahadeo Hills (five examples from Khapa, Dhiam and Pachmarhi, in Hoshangabad District, and one from Ouda in Balaghat District). The specimens from Amarkantak under report, however, extends its distribution farther eastwards.

Systematic position: The coloration of the nape has been generally given importance for the subspecific classification of *Lepus nigricollis.* Wroughton & Ryley (1913, p. 15) report that the nape in the type-series of *L. n. mahadeva* is grey, that is, similar to that of *L. n. simcoxi.* In the specimens under report, however, the grey nape is suffused with buff. The amount of buffy suffusion appears to be due to locality and increases gradually from west to east, the easternmost population tending towards *ruficaudatus.* It would appear that *mahadeva* is somewhat intermediate between *simcoxi* and *ruficaudatus*, rather than '. . . representative of *simcoxi* in the altered condition of hilly country, . . .' (Wroughton & Ryley, 1913, p. 16).

General Remarks: By possessing large tracts of bush and jungle interspersed with cultivated patches, Madhya Pradesh forms a very suitable area for hares. Due to varying physiographic and climatic conditions within this State, at least three subspecies of hares are known to occur there. These three subspecies can be separated with the help of the following key:

1.	Nape rufous or ochraceous; general body colour dull or darker, but the face, head and body not strongly washed with black; tail rufous brown ...	*ruficaudatus*
	Nape smoke grey, grey or grey with buffy suffusion ...	2
2.	Nape smoke grey; general body colour lighter than *mahadeva* and *ruficaudatus*; tail above blue black; grey patch on the rump ...	*simcoxi*
	Nape grey or grey with buffy suffusion; general body colour richer and brighter than *ruficaudatus*; face, head and body strongly washed with black; tail above dingy rufous—the individual hairs black with buffy tips; absence of grey patch on the rump ...	*mahadeva*

As mentioned earlier the ranges of the three subspecies of *Lepus nigricollis* found in Madhya Pradesh have not been clearly defined so far. On the basis of the specimens present in the Zoological Survey of India and such information as are available in literature, it would appear that: (1) *L. n. ruficaudatus* occupies the northern slopes of the Mahadeo and Maikal ranges and the northern plains of Madhya Pradesh; (2) *L. n. mahadeva* occurs on the higher parts (c. 549-1065 m.) of Mahadeo and Maikal ranges of Madhya Pradesh in Hoshangabad, Balaghat and Shahdol Districts; and (3) *L. n. simcoxi* is distributed on the southern slopes of Mahadeo and Maikal ranges and the adjacent plains of Madhya Pradesh and Maharashtra from Khandesh as far east as Bhandara District. It also occurs in the south-western slopes and adjacent plains of Mahadeo Hills.

Two of the Mammal Survey specimens (now in the Zoological Survey of India) from Sleemanabad, Jabalpur District, and Mundra, Saugor District, that were originally identified as *simcoxi*, appear on closer examination to agree with *ruficaudatus*. Wroughton & Ryley (1913, p. 57) also suggested that specimens from Mundra (Saugor District), Damoh and Narsingarh (Damoh District) perhaps go better with *ruficaudatus*.

ACKNOWLEDGEMENTS

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ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA,
September 6, 1966.

R. K. GHOSE

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3. A NOTE ON *CAPRA HIRCUS BLYTHI* HUME, 1875

Whilst writing this note as a sequel to an earlier one on *Ovis orientalis*, I feel it desirable to explain my purpose. My knowledge of this species is still meagre and I hope to increase it by further field trips. But by summarising information gleaned up-to-date, I hope to stimulate similar observations from other amateur naturalists like myself, as well as to reveal observations about this wild goat which are either at variance with, or hitherto not recorded in the published accounts, which I have been able to see.

Most modern Zoological works recognise five species of true goats or caprinae (Walker 1964). West Pakistan is fortunate in being within the range of three of these species and all are most impressive and handsome beasts. They include the Siberian race of the Ibex, several races of the Markhor, and the Persian Wild Goat or Sind Ibex, about which this note is written.

Capra hircus is considered by some authorities to be the ancestor of all domestic goats, and its range extends from the Greek Islands of the Mediterranean, through the Caucasus, Asia Minor, and Iran to the south-western portion of West Pakistan (Ellerman & Morrison-Scott 1951). The race *C. h. blythi* which inhabits parts of southern Baluchistan and the Sind border, is apparently distinguished mainly by its smaller size (Prater 1965). A specimen of *C. h. aegagrus*, which I have seen from the Island of Crete, appears identical with the Sind Ibex, except for having a much thicker, denser, coat. Specimens from northern Kalat in Baluchistan also have a very woolly coat. At one time (Lyddeker's GOATS AND SHEEP OF THE WORLD) it was believed that the two races could be distinguished by the number and prominence of the knobs or irregularities which occur on the front keel of the horns. Those of *C. h. aegagrus* being considered more prominent than *C. h. blythi.* However, such an authority as Col. C. H. Stockley could not distinguish any marked difference between specimens from Taurus Range of southern Turkey and from the Kirthar Hills—places at opposite poles of its range (Stockley 1928). I feel, therefore, that it still remains for future workers to clarify as to what distinguishes these two races of *C. hircus* and even to determine whether *C. h. blythi* should be separated as a valid race.

Appearance. The magnificent appearance of old bucks with their silver-grey livery and dark spinal stripe set off by sweeping scimitar-shaped horns, has been well described by other writers. Though it would be misleading to imply that the three species *C. hircus*, *C. falconeri* and *C. ibex* are not easily recognisable in the field by their different coloration, yet there are a number of striking affinities in their external appearance. Except for the fact that *C. hircus* has short coarse hair, with no under wool at all seasons it shares with *C. falconeri* the same crest of longer coarser hairs extending in a ridge down the centre of the hind neck and between the shoulders. These two species also have white hair on the belly and inside their legs, whilst *C. ibex* has brownish yellow hair on its belly. However, *C. hircus* shares with *C. ibex* the same characteristic pattern of dark hair down the front of the forelegs, though only the former has white wrist patches. Both have a line of dark hair running down the spine and darker hair in the region of the lower chest though this is very distinct and sharply defined in *C. hircus* and much less so in *C. ibex* due to the woolly nature of its pelage.

In *C. hircus* the dark line which extends down the spine, does not actually start from the nape as stated by Prater (loc. cit. page 255). The hind neck is pure greyish white and the dark stripe starts from the shoulder. It is dark brown and only the tail and the rather scant beard are truly black. The dark brown spinal stripe extends on either side in a diagonal line in front of the shoulders, merging into a generally dark area on the chest. Even in young bucks, the dark brown of the chest is conspicuous and the plate in, Prater (loc. cit. Plate 60) is misleading in this respect. With the exception of the black beard, the hair of the throat and between the jaws is white and there is a noticeable whitish fawn streak extending from above the eye down either side of the nose which is a characteristic pattern in the faces of the females and immature animals as well as the older males. Another noticeable feature of both young and old bucks, not clearly shown in Prater's illustration, is the dark band of hair along the front edge of the upper hind legs, which extends in a continuous line from the hock through the stifle (knee) and along the flank of the lower belly. This dark line which separates the white hair of the belly from the greyish brown of the flanks usually becomes indistinct in the middle of the body but becomes more apparent again in the pectoral region. Younger males and does have similar darker brown faces but the rest of their body is a brownish yellow which becomes paler in summer, bleaching almost to a buff colour. This is in contrast to the reddish tones of the Urial which live in the same area or the red colour of the Suleiman Markhor whose range meets that of *C. hircus.* So this paler sandy coloration cannot be attributed to a protective adaptation to their environment. It is only the older bucks—probably from their fourth year onwards, that show increasing amounts of white hairs mixed with the brown. These white hairs are more dense on the nape and along the top of the back, gradually becoming more sparse on the lower shoulder and almost absent from the lower hind quarters even in aged bucks.

From captive or freshly killed specimens which I have seen, *C. hircus* has a golden brown or tawny iris as does *C. falconeri* whilst *C. ibex* has a slightly darker brown iris. The Urial has a greyish yellow iris. The pupil contracts to a horizontal slot characteristic of both sheep and goats. Its tongue is bluish black and the roof of its upper palate is ridged. The incisors in the lower jaws are surprisingly small and close packed so that the muzzle is quite narrow. The female of *C. hircus* has no trace of a beard whereas the female of both *C. falconeri* and *C. ibex* have quite substantial beards. There is no trace of any scent gland below the eye and out of four males which I have been able to examine, I could not find any pedal glands (external orifice) in the pastern of the front or hind feet.

Though much bigger than any domestic goat from this region, *C. hircus* is still a relatively slim bodied animal with a slender neck as compared with *C. ibex*. In contrast, therefore, its horns look particularly massive and an old buck's horns, sweep right back till the tips are over its pelvis. Even the females may carry horns up to 14″ in length. They probably live normally up to 10 or 12 years and a mature animal of say 8 years of age may carry horns 41″ to 46″ length. Anything over this is exceptional and the actual length as well as the circumference of the horn depends considerably upon whether the animal was born one of twins or even triplets, or was a singleton. I have measured two males, one with horns of 40¾″ and the other of 36″, both of which bore seven clear annular rings, and therefore, might be presumed to be of similar age.

The very young kids are a silky-grey colour in sharp contrast to the yellowish brown colour of their dams. Their ears also appear comparatively longer. *C. hircus* like all the caprinae, frequently elevates its tail and this is a characteristic carriage which is never observed in wild sheep; a point worth mentioning since the differences between these two genera are so slight.

Distribution. At the present time in Pakistan, *C. h. blythi* is confined to the remoter hill ranges of Las Bela, south-eastern Kalat and the coastal hills of Mekran. Its easternmost limit is the Kirthar Range on the borders of Sind. It still occurs on the peninsula of Ormara and other areas right on the sea coast. Its stronghold is perhaps in the hills which border the Hingol River in Mekran and there is a reserve at Hinglaj. It also occurs in the Khudi Range and the Pub Hills of Las Bela and in the Shah Nurani Hills on the Kalat border. Most of these places are very inaccessible but I would guess that its status in these areas is still reasonably secure, since these hill-ranges offer refuge in the shape of precipitous cliffs, where even domestic goats, let alone hunters, cannot penetrate. However, it is nowhere numerous and it is much persecuted for its meat except within the area of the Hinglaj and Kirthar reserves. The latter extends for about 12 miles north and south and is roughly 2 to 3 miles in width and I estimate that about 800 to 1000 head still survive in the Kirthar. According to the Chief Game Warden, about 20 to 25 bucks are shot there annually by Licence holders. No doubt some poaching also occurs and leopards are always active in the area.

Habits. It would be a fair generalisation to state that in West Pakistan the Markhor inhabits mountain areas from 7000 feet and upwards whilst the Himalayan Ibex will rarely be found below 10,000 feet. But *C. hircus* is not restricted to higher elevations by any means and is tolerant of exceedingly high temperatures as well as very arid conditions. However, it must have precipitous rock faces for refuge, and shelter which provides shade from the direct rays of the sun; not an easy condition to fulfil in this treeless region. Fortunately both shade and refuge is generally provided in these lower Baluchistan ranges which consist of limestone rock that contain many wind fretted hollows, ledges and caves. The Kirthar Range with which I am familiar, for example, is only 3200 feet at its highest point, but it consists of a series of escarpments rising from the surrounding plains by sheer cliff walls which bound both its east and west faces. Some of these cliffs quite literally ascend for almost 2000 feet in an unbroken vertical face. Yet it is in the narrow eroded gulleys and crevices of these cliffs that *C. hircus* finds its ultimate refuge. Many writers have commented on their extreme agility and it remains for future researchers to analyse with the help of high powered telescopic lenses and slow motion cine film, the means by which they often seem able to defy gravity. Were it not for the testimony of one's own eyes, I would often have found it difficult afterwards to believe that an animal could have traversed certain areas upon closer examination. Yet I have seen Ibex of all ages descending quite unhurriedly, completely vertical rock faces, and traversing diagonally, other rock faces which looked completely smooth and appeared to slope at an angle of over 80 degrees of arc. Conversely, they are capable of quite prodigious leaps and can carom off a vertical rock face to reach a ledge higher up, which in itself offers no more than a toe-hold.

In descending very steep rock they splay out their forefeet which are rigidly extended and not bent and at the same time they place the whole of their metatarsus on the ground. I have noticed that their fourth and fifth rudimentary phalanges are equipped with very large rounded and flexible horns or nails which are also roughened and undoubtedly assist in breaking their downward descent. I have also noticed that when crossing a steep rock face they can lean their body inwards and cross both fore and hind legs as they move forward and still keep the whole of the foot surface on the rock. It is also interesting to note that the lower part of their wrists (forelegs) and their sternum bear thick roughened callosities which no doubt give protection on the hard sharp rocks on which they constantly have to lie when resting. Except on camels I have not noticed similar callosities. The sole of their hooves also seem unique, in that they are slightly soft and rubbery; quite unlike the hard horn of domestic goats or even wild sheep. I have not examined this feature properly as yet, but presume the provision gives the feet greater shock absorbing qualities as well as friction on hard smooth surfaces. The rut or breeding season coincides with the onset of the monsoon which, in southern Baluchistan starts in late July and sometimes persists till mid September. The older bucks fight amongst themselves during this season and collect harems of does which keep together and feed constantly in the vicinity of the buck. The young are mostly born in the latter part of January and twins are quite common in a year when monsoon rains have been adequate. It would appear that the gestation period is 5 months or possibly 5½ months. Certainly it seems shorter than that of the Urial (*Ovis orientalis*). In contrast to what Prater has written (loc. cit. page 256), I have seen very young kids, only from mid January to early February, though there must be exceptions since Blanford saw a very young one caught on March 11th (Sterndale 1929). In the first two weeks after birth the kid(s) mostly remains concealed in some rock crevice where the dam periodically comes to suckle it (them), after feeding only in the immediate vicinity. At this time the does with young do not venture out on to the more open escarpments where grazing is much better. Provided one is a good climber, the new born kids are not too difficult to capture at this stage as are the newly born young of Markhor and Ibex. However, the Sind Ibex invariably dies soon after capture, possibly from shock and I have never seen any in captivity in Pakistan whereas many Ibex and Markhor have been successfully reared when captured in this way. As mentioned earlier, breeding depends largely upon the extent of the monsoon and triplets may be observed after a year of plentiful rain whereas in a drought year, hardly any females conceive at all. This year for example, I have seen only single young in the Kirthar and no twins and it is noteworthy that the monsoon rains were considered less than usual.

C. hircus appears to be entirely independent of water in the winter and early spring months and to be able to obtain enough moisture from dew on the herbage from late July until early October. However, it has been observed to drink when water is freely available despite what other authorities have written (Stockley 1936: 125) and in the months of April, May and June it will go to great lengths to assuage its thirst. I have been told of an actual instance where a Baluch shepherd surprised 5 Sind Ibex at the bottom of a 14 feet vertical well. Three animals leapt out despite his efforts to surprise and kill the lot. The others, according to the shepherd, got their hooves wet and so were unable to ascend the walls but slipped backwards and he was able to kill them.

It has already been noted by other writers that the old males tend to separate by themselves or to congregate into small herds after the rut is over. I have seen such herds often comprising eight or nine old bucks, their horns looking almost like a forest of trees in the dawning rays of the sun. But it is not uncommon to see mixed herds even in late January with old and young bucks as well as ewes and yearlings feeding together. Such congregations probably depend on the amount of disturbances which the animals suffer and also the extent of their feeding range. Markhor by comparison are nearly always more dispersed by the very nature of the ground on which they live and feed. Sind Ibex congregate in bands of from 4 or 5 individuals up to 15 or 20. Their food consists of grasses, leaves of various thorny bushes, as well as various xerophytic herbs and shrubs which they masticate, in typical ruminant fashion, during the long hours of day light when they are lying up and resting. They normally feed in the very early hours of morning and late evening at least in the winter months but I believe that in the height of summer they feed throughout most of the night relying upon their sentries to protect those who are feeding from any marauding leopard. Their sense of sight and smell appears to be very acute.

Though they will rest on the crown of some commanding ridge in comparatively open country, the older bucks invariably retreat to the most inaccessible cliffs and actually sleep inside caves or within rock crevices, where they are so well concealed that even the near approach of man or four legged predators, will not cause them to budge though the younger bucks and females may all have fled in panic. In this respect they seem to have learned the greater safety which lies in concealment rather than flight, in the manner of the Goral, though even young and females of this latter species will allow very close approach when lying concealed.

They are normally not very vocal but I have heard young kids bleating when trying to catch up with their mothers and their cries sounded identical to that of domestic kids. When alarmed a member of the herd gives a warning snort which is very hard to describe verbally. But it is an explosive sound quite unlike the bird-like chirrup of Himalayan Ibex or the sneeze of Markhor when alarmed.

ROBERTS COTTON ASSOCIATES LTD.,
KHANEWAL,
WEST PAKISTAN,
February 20, 1967.

T. J. ROBERTS

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4. REOCCURRENCE OF THE WHITEFRONTED SHEARWATER (*PROCELLARIA LEUCOMELAENA* TEMMINCK) IN INDO-CEYLONESE WATERS

While working upon a new checklist of Ceylon Birds, I have noticed that Dr. Dillon S. Ripley, in his excellent SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN mentions only a single record of the occurrence of the Whitefronted Shearwater (*Procellaria leucomelaena* Temminck) in the Indian Ocean.—viz.. a bird obtained off Ceylon in 1884. It seems advisable, therefore, to place on record a more recent occurrence of the species in Indo-Ceylonese waters.

Early in 1957, when I returned to Ceylon from the Maldive Islands, I met Mr. Grisenthwaite, who had already collected a number of interesting birds at sea off the western coasts of Ceylon. From him, I received a large Shearwater which proved to be *Procellaria leucomelaena* Temminck. I brought the specimen to England with me and donated it to the National Collection, at the South Kensington Museum where it now carries the number 957.16.98.

The data labels, written from information supplied by Mr. Grisenthwaite, show that this bird was taken, about dawn, on 6th December 1956, by Mr. G. N. Grisenthwaite aboard the Trawler 'Braconglen' when the ship was approximately 22 miles W. SW. of Muttum Light on the south Indian coast, or approximately 22 miles N.W. of Cape Comorin. The bird was a male in sub-adult plumage. The prevailing weather conditions, at the time of capture, were:

Wind moderate, easterly; bright sun later. Bird was flying east and appeared to be tired as it dropped exhausted on the ship.

This Shearwater appears to be an extremely rare vagrant to the Indian Ocean, its normal range being in the northern Pacific.

'Storth,'
Manor Way,
Aldwick Bay,
Bognor Regis, U. K.,
January 25, 1967.

W. W. A. PHILLIPS

5. ON THE OCCURRENCE OF THE GREAT WHITEBELLIED HERON *ARDEA INSIGNIS* HUME IN BIHAR

On 1 March 1964 at 5 p.m. I saw five Great Whitebellied Herons *Ardea insignis* Hume near Jamalpur, Darbhanga District, feeding in a water-logged, harvested rice field. They did not heed my close approach to about 30 ft. After taking notes I tried to get still nearer when two of them rose silently only to settle a little farther ahead. They were rather confiding. Another bird was seen on 5 March, soaring at a height of about 200 ft. over a channel of the Kosi River at Nirmali, Saharsa District. On 10 March two more birds were observed sitting on a leafless tree near Beluva, 6 miles north-east of Birpur, close to the India-Nepal border. The identification is based on the field notes, which were later checked with the specimens in the Society's Research collections. This grand heron can easily be identified in the field by its great size (bigger than the Painted Stork), long ashy-grey nuchal crest, and the grey upper parts contrasting with the white under parts. In flight the white axillaries are confirmatory.

Ripley (1961) gives the range of *Ardea insignis* (=*Ardea imperialis*) thus: 'From the Nepal and Sikkim terai east along the Himalayan foothills through north-east Assam, south to East Pakistan and Arakan and east to northern Burma'. Biswas (1960) did not come across this bird in Nepal.

Bombay Natural History Society,
Hornbill House,
Bombay, 1-BR.,
June 10, 1965.

P. V. GEORGE[1]

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[1] Present address : Curator of Birds, Iraq Natural History Museum, Waziriya, Baghdad, Iraq.

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——— (1963): Comments on Ripley's A Synopsis of the Birds of India and Pakistan. op. cit.: **60** (3): 679-687.

Ripley, S. D. (1961): A Synopsis of the Birds of India and Pakistan. Bombay Natural History Society.

6. ON THE OCCURRENCE OF THE BLACKNECKED STORK [*XENORHYNCHUS ASIATICUS* (LATHAM)] IN THE BOMBAY KONKAN

On 26 February 1967, S. Chaudhuri and I stopped at the Wada Tank, Bhiwandi Taluka, Thana District, Maharashtra, to look at birds. A huge bird in a silted and reedy patch on the far side puzzled us in the distance. Upon closer approach it proved to be a Blacknecked Stork [*Xenorhynchus asiaticus* (Latham)] which, though generally said to be found all over India, does not appear to have been recorded in the Konkan, nor for that matter anywhere in the adjacent Deccan.

The nearest records are Dabka (Baroda) and Gwalior in the north and Borgampad on the Godavari, far to the east in Andhra Pradesh. In E. H. Aitkens's copy of Barnes's BIRDS OF BOMBAY however, there is a handwritten note referring to one seen at Dasgam on the Bankot River in Ratnagiri District, south of Bombay, on 4 April 1897—just 70 years ago!

75, Abdul Rehman Street,
Bombay 3,
March 23, 1967.

HUMAYUN ABDULALI

7. OCCURRENCE OF THE WRYNECK *JYNX TORQUILLA* LINNAEUS IN KERALA STATE, SOUTH INDIA

On 10 March 1967 in a fuel clearing of Red Gums on Granby Estate, Vandiperiyar P.O., Kerala State, my attention was attracted by a bird which suddenly flew out of long grass at ground level at the side of a foot-path on which I was walking.

My first impression was that it was an immature Brown Shrike, but after it had alighted in a Red Gum tree (*Eucalyptus robusta*) I was able to look at it through binoculars. Its conical pointed beak, a dark band reaching from the crown to the upper back, and another dark band through the eye together with the vermiculated brown plumage gave me a clue to the identity of the bird.

When it flew to another tree close by and ran up the stem for about three feet before sitting along a branch instead of across it, I was pretty certain I was looking at a Wryneck, although the last member of this species that I had seen was in Oxfordshire about 35 years ago.

I was able to observe the bird for about 10 minutes until it flew some distance away. Its flight was undulating with rather rapid wing beats.

During the time I had it under observation it was completely silent.

The description in the FAUNA confirmed my identification, but I was puzzled by the lack of any reference to the dark bands across the tail which I had noted. I therefore turned to Jerdon whose description is much fuller and here I confirmed that the tail has three darker broad bands and a fourth subterminal one.

Generally the bird seemed to be in rather dishevelled condition; so much so that at times the feathers on the crown appeared to form a crest.

Apparently no specimen of the species has been procured farther south than Mysore (Sálim Ali on 17-12-1939)[1] although Jerdon stated he obtained it in Nellore and Madras many years ago.

Curiously enough a friend of mine who has just been visiting the Nilgiri-Wynaad in Madras State has told me that he saw a Wryneck on Cherambadi Estate, Cherambadi P.O. in the middle of March.

He observed this bird in scrub jungle through binoculars and he thinks there may have been another with it but he was unable to get a clear view of the second bird.

I should be interested to know if the species has been observed in Kerala or in Madras in recent times.

PANDAVARMEDU,
VANDIPERIYAR P.O.,
March 16, 1967.

M. C. A. JACKSON

[E. G. Nichols (1944): 'Occurrence of Birds in Madura District' Vol. **44** p. 575 of this *Journal*, reports seeing Wryneck near Batlagundu at the base of the Palni Hills in December, and also another sight record by a friend at Kodaikanal in November.—EDS.]

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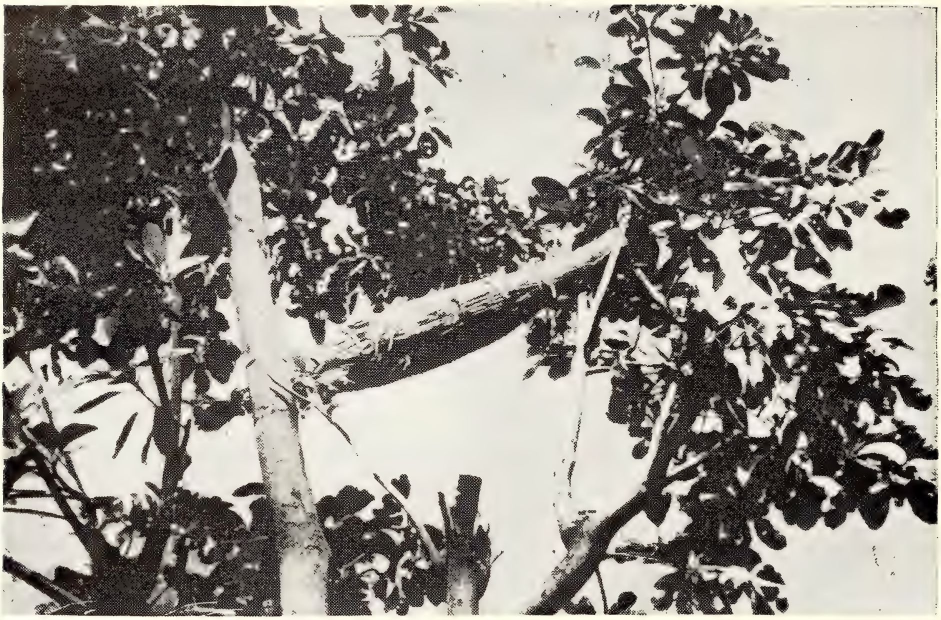
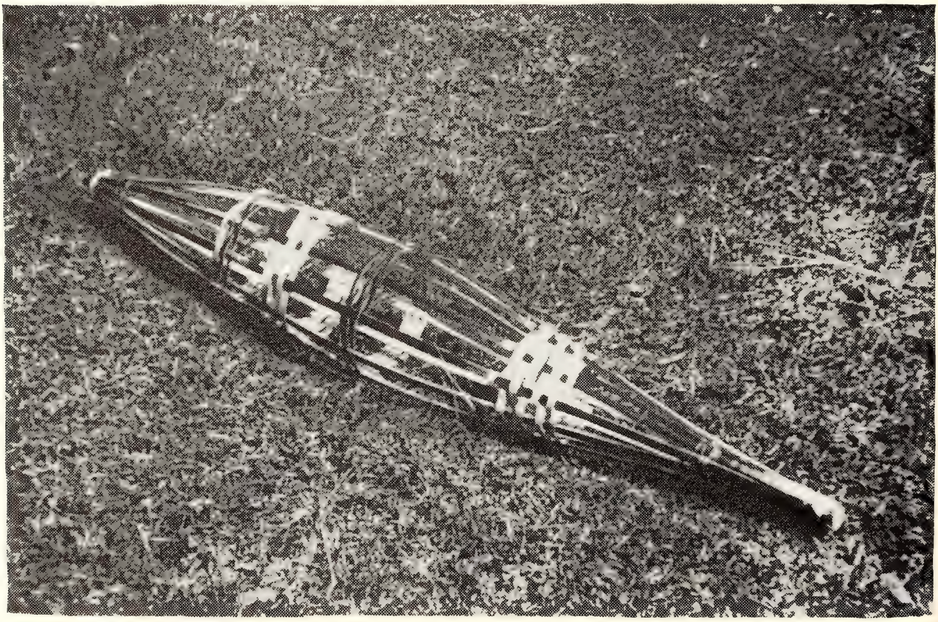
[1] SÁLIM ALI (1943): The Birds of Mysore. *J. Bombay nat. Hist. Soc.* **43**: 594.



Artificial nest in position



Bamboo framework of nest

(Photo : Brian Bertram)

8. HILL MYNA *GRACULA RELIGIOSA* LINNAEUS BREEDING IN ARTIFICIAL NESTS IN GARO HILLS, ASSAM

(*With a plate*)

The Indian Hill Myna or Grackle (*Gracula religiosa*) is a wary arboreal bird in the wild state in its evergreen-forest habitats in south-west and north-east India. It is widely known for its prowess as a talking bird when in captivity, for it surpasses even the parrots in the accuracy of its imitations. A Hill Myna will learn to talk well only if it has been taken from the nest while young, and since Hill Mynas are wary birds and nest usually in inaccessible holes in trees, the taking of their young is often a difficult problem. The difficulty is reduced in the Garo Hills District of Assam where the Hill Mynas are persuaded to breed in artificial nests. Such a nest consists of a framework of split bamboo about 5 feet long and 1 foot wide at the middle, tapering towards each end (Plate); this is thickly covered on the outside with thatching straw tightly tied down onto the framework. A hole is cut about two-thirds of the way from the slightly thicker lower end of the nest, which is then attached to the branches of a tree at an angle of about 45 degrees, with the hole at the higher end and pointing downwards. The trees chosen are usually tall, and are situated in, or at the edge of, clearings in the forest, or at the edge of a small village; the nests are at or near the tops of the trees. A Garo may have 4 or 5 of these nests, in different trees, and by observation he can tell when there are young birds in the nest. Usually he does not want to run the risk of their fledging and escaping, and so he takes the young from the nest earlier than is desirable, feeds them on a not-very-adequate diet of gram-powder made into large plugs and pushed down the gaping throat, and then sells them at the weekly market or 'hat' at prices usually between Rs. 10 and Rs. 20. Dealers then take them on via Goalpara to Calcutta.

The practice of putting up these artificial nests in the Garo Hills is an old one, certainly much older than the recent huge demand for young mynas for export. It is not done in other parts of India for the catching of Hill Mynas; possibly it arose as a simple way of catching birds, indiscriminately of species, in order to eat them. As with the hill people of Orissa and Nepal, the Garos also catch the young of Hill Mynas which nest naturally in holes in trees, but the majority of young mynas leaving Assam for a life in captivity have probably been hatched in these artificial basket nests. The advantages to the Garo are obvious: he has a good source of revenue, collected with little difficulty since the nests are obviously accessible; he can observe the nests easily and can take the young before they fledge; and having the nests often near his house he can prevent the young birds from being taken by his neighbour—it is obvious to whom they belong. But what makes the mynas, which usually nest only in tree holes, make use of bamboo-and-grass baskets is very difficult to understand, although there are a great many possible reasons to be examined. But since mynas which nest in these baskets rarely succeed in rearing any young, there must be very strong selection pressure against the habit; perhaps in a couple of decades they will scarcely do so any more. A few thousand young mynas are taken out of Assam each year, largely for export. This represents quite a large drain, but is less serious than it would appear for two reasons: first, that if the young birds are taken from the nest, the parents usually nest again, and second, that the taking of young mynas from Assam is at present largely confined to the Garo Hills District only. Control measures would be easy to apply, but are probably not yet necessary; they may well become necessary if the trade in young mynas continues to expand.

BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE,
APOLLO STREET,
BOMBAY-1,
January 30, 1967.

BRIAN BERTRAM

9. RECOVERY OF RINGED BIRDS

Ring No. and species	Date and place of ringing	Date and place of recovery	Remarks
A-25904 *Passer domesticus parkini* ♀	28.3.1963. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′ E.) India	+0.9.1966. Tadjik, S.S.R. near Kulyab (37°52′ N., 69°50′ E.)	Reported by Bird Ringing Centre, Moscow, U.S.S.R.
AB-8245 *Philomachus pugnax* ♀	1.10.1965. do.	23.11.1966. Kolhi Garib Village, Gonda, U.P. (*c.* 27°10′ N., 81°50′ E.)	Reported by Mohammed Siddiqui
AB-8926 *Philomachus pugnax* ♀	17.10.1965. do.	+18.12.1966. Laheria Sarai, Darbhanga Dt. India (*c.* 26°10′ N., 85° 54′ E.)	Reported by Dr. B. N. Sinha, Darbhanga Medical College, Bihar.
AB-8614 *Philomachus pugnax* ♀	11.10.1965. do.	4.9.1966 Omsk Region, Manjanovka District, Piketnoe Lake. (55° 00′ N., 72°15′ E.)	Reported by Bird Ringing Centre, Moscow, U.S.S.R.
B-731 *Streptopelia tranquebarica*	13.9.1961. Victoria Park, Bhavanagar *c.* (21°45′ N., 72°15′ E.) India	27.3.1967. Fateh Mohammed Village, 18 miles from Karachi, W. Pakistan. (*c.* 24°37′ N., 67°05′ E.)	Reported by Mr. Gulam Haider of Karachi
C-165 *Anas crecca* ♀	18.2.1964. Manjhaul, Monghyr Dist., Bihar (*c.* 25°23′ N., 86°30′ E.)	17.3.1967. Near Lucknow, U.P., India (*c.* 26°51′ N., 81° E.)	Reported by M. Sardar Khan
C-327 *Anas crecca* o?	6.2.1964. do.	+0.9.1966. Irkutsk Region, near Kuitun (54°22′ N., 101°30′ E.)	Reported by Bird Ringing Centre, Moscow, U.S.S.R.
C-315 *Anas crecca* ♀	4.2.1964. do.	10.9.1966. Chita Region, near Borzya, (50°24′ N., 116°32′ E.)	do.
C-439 *Anas crecca* ♂	28.11.1964. do.	4.9.1966. Novosibirsk Region, Chany Lake (55°00′ N., 78° 00′ E.)	do.
C-450 *Anas crecca* ♀	29.11.1964. do.	+18.8.1966. Krasnojarsk Region, Partizanskii District, near Rytbnoe (55°18′ N., 97°20′ E.)	do.

RECOVERY OF RINGED BIRDS (*contd.*)

Ring No. and Species	Date and place of ringing	Date and place of recovery	Remarks
C-1013 *Anas querquedula* o?	28.9.1965. Bharatpur	Autumn 1966, Novosibirsk Region, Chany Lake, near Kupino (54°22′ N., 77°18′ E.)	Reported by Bird Ringing Centre, Moscow, U.S.S.R.
C-1225 *Anas crecca* ♂	8.10.1965. do.	+2.1.1967 Jammu Tawi, Jammu, India (*c.* 32°30′ N., 75° E.)	B. S. Jamwal of Jammu Tawi
C-1257 *Anas querquedula* ♂	14.10.1965. do.	10.10.1966. Omsk Region, near Nizhnyaya Omska (55° 30′ N., 74°55′ E.)	Reported by Bird Ringing Centre, Moscow, U.S.S.R.
C-1291 *Anas querquedula* ♀	17.10.1965. do.	+18.9.1966. Alma Ata Region, Alakol Lake (44°52′ N., 74° 12′ E.)	do.
C-1397 *Anas crecca* o?	9.10.1966. do.	+7.3.1967. Tadjik S.S.R. near Dangara (38°06′ N., 69°25′ E.)	do.
C-1420 *Anas crecca* ♂	8.10.1966. do.	+8.3.1967. Kazakh S.S.R., near Kurdai (43°20′ N., 75°00′ E.) Dzhanbul Region	do.
C-1431 *Anas crecca* ♂	9.10.1966. do.	+10.3.1967. Alma Ata Region, near Turgen (43°21′ N., 77°36′ E.)	do.
C-1558 *Anas crecca* ♂	11.10.1966. do.	2.12.1966. Sialkot, W. Pakistan (*c.* 32° 30′ N., 74°32′ E.)	Reported by Muktar Ali Khan
C-1625 *Anas crecca* ♂	11.10.1966. do.	+4.3.1967. Uzbek S.S.R., near Chardar (41°17′ N., 67°58′ E.)	Reported by Bird Ringing Centre, Moscow, U.S.S.R.
C-1635 *Anas crecca* ♂	12.10.1966. do.	+23.1.1967. Nahar, Multan District, W. Pakistan (*c.* 30°10′ N., 71° 30′ E.)	Reported by Mr. Atta Mohammed
C-1638 *Anas querquedula* ♂	12.10.1966. do.	+8.1.1967. Siddipet Village (18°6′ N., 79°1′ E.) Andhra Pradesh, India	Reported by the Nazir of the Ist Class Magistrate, Siddipet
C-1720 *Anas crecca* ♂	4.12.1964. Manjhaul Bihar	19.2.1967. Mokamaghat, Patna Dist., Bihar (25°25′ N., 85°53′ E.)	Reported by Rajendra Prasad Singh

RECOVERY OF RINGED BIRDS (*contd.*)

Ring No. and species	Date and place of ringing	Date and place of recovery	Remarks
C-1744 *Anas crecca* ♂	5.12.1964. do.	+ 16.10. 1966. Alma Ata Region, near Andreevka (45°49′ N., 80°38′ E.)	Reported by Bird Ringing Centre, Moscow, U.S.S.R.
C-1853 *Anas crecca* ♀	30.12.1964. Bakhri Monghyr Dt., Bihar	4.5.1966. Selenga River, near Baikal Lake (52°21′ N., 106° 31′ E.)	do.
C-1909 *Anas crecca* ♂	3.1.1965. do.	+25.10.1966. Uzbek S.S.R., near Fergana (40°22′ N., 71°47′ E.)	do.
C-2621 *Anas crecca* ♂	19.10.1966. Bharatpur	+8.3.1967. Uzbek S.S.R., near Samarkand. (39°47′ N., 66°56′ E.)	do.
C-2652 *Anas crecca* ♂	19.10.1966. do.	+10.3.1967. Fergana Region, near Kirovo. (40°27′ N., 70° 36′E.)	do.
C-2661 *Anas crecca* ♂	19.10.1966. do.	+9.3.1967. Tadjik S.S.R. Leninobad District, near Proletarsk. (40°11′ N., 69°29′ E.)	do.
C-2685 *Anas crecca* ♀	20.10.1966. do.	5.12.1966. Kushtia Town (23° 55′ N., 89°9′ E.) E. Pakistan	Reported by Mr. S. G. Meerza
C-2851 *Anas crecca* o?	23.10.1966. do.	11.3.1967. Numberdar Rajoya Saddat Chiniot, Dist. Jhang, W. Pakistan (*c.* 31°40′ N., 73° E.)	Reported by Mr. Syed Mohammed Afzal
F-1146 *Anas acuta* ♂	19.10.1965. do.	+14.9.1966. Kokchetav Region, near Kokchetav (53°17′ N., 69°25′ E.)	Reported by Bird Ringing Centre, Moscow, U.S.S.R.
F-1189 *Anas acuta* ♀	6.10.1966. do.	+19.3.1967. Alma Ata Region, near Turgen (43°21′ N., 77°36′ E.)	do.
F-1505 *Anas clypeata* ♂	21.10.1966. do.	23.1.1967. Nabi Shah Jheel, Bhalwal 20 miles north of Sargodha (*c.* 32°. 20′ N., 72°50′ E.) W. Pakistan	Mr. G. Q. Dean Mann of Sargodha

RECOVERY OF RINGED BIRDS (*contd.*)

Ring No. and species	Date and place of ringing	Date and place of recovery	Remarks
F-1542 *Anas clypeata* ♂	24.10.1966. Bharatpur	Report dated 26.12.1966. Samana, Patiala, India (30°9′ N., 76°15′ E.)	Dr. Paul Singh Bhullar of Samana, Patiala
F-3033 *Anas acuta* ♀	15.2.1966. Chabua, 12 miles north of Dibrugarh, Assam (*c.* 27°41′ N., 94°41′ E.) India	5.10.1966. near Kupino, Novosibirsk Region (54°22′ N., 77° 18′ E.)	Reported by Bird Ringing Centre, Moscow, U.S.S.R.

Note. + = Shot or killed by man.

BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE,
BOMBAY 1-BR,
May 10, 1967.

EDITORS

10. OCCURRENCE OF *DRACO BLANFORDI* BOULENGER (SAURIA : AGAMIDAE) IN ASSAM, INDIA

(*With a plate*)

Among the unidentified lizards from Assam in the Zoological Survey of India, one specimen of *Draco* (Regd. No. 21698, Z.S.I.) collected on 16 February 1936, from Kambiron, *c.* 95 km. (59 miles) west of Imphal on Silchar Road in Assam, on examination proved to be *Draco blanfordi* Boulenger, a species commonly occurring in parts of Burma, Western Thailand and Malay Peninsula but hitherto unrecorded from India.

Though the colour of the specimen has faded due to long preservation in alcohol, the pattern is more or less visible, and consists of small dots arranged in pairs along the back, those on the neck and shoulder being clear. The wing has four transverse bands with spots at regular intervals, and fine longitudinal lines.

Smith (1935: 142)[1] gives the distribution of *D. blanfordi* as 'Western Siam; Southern Burma; the Malay Peninsula. I have seen

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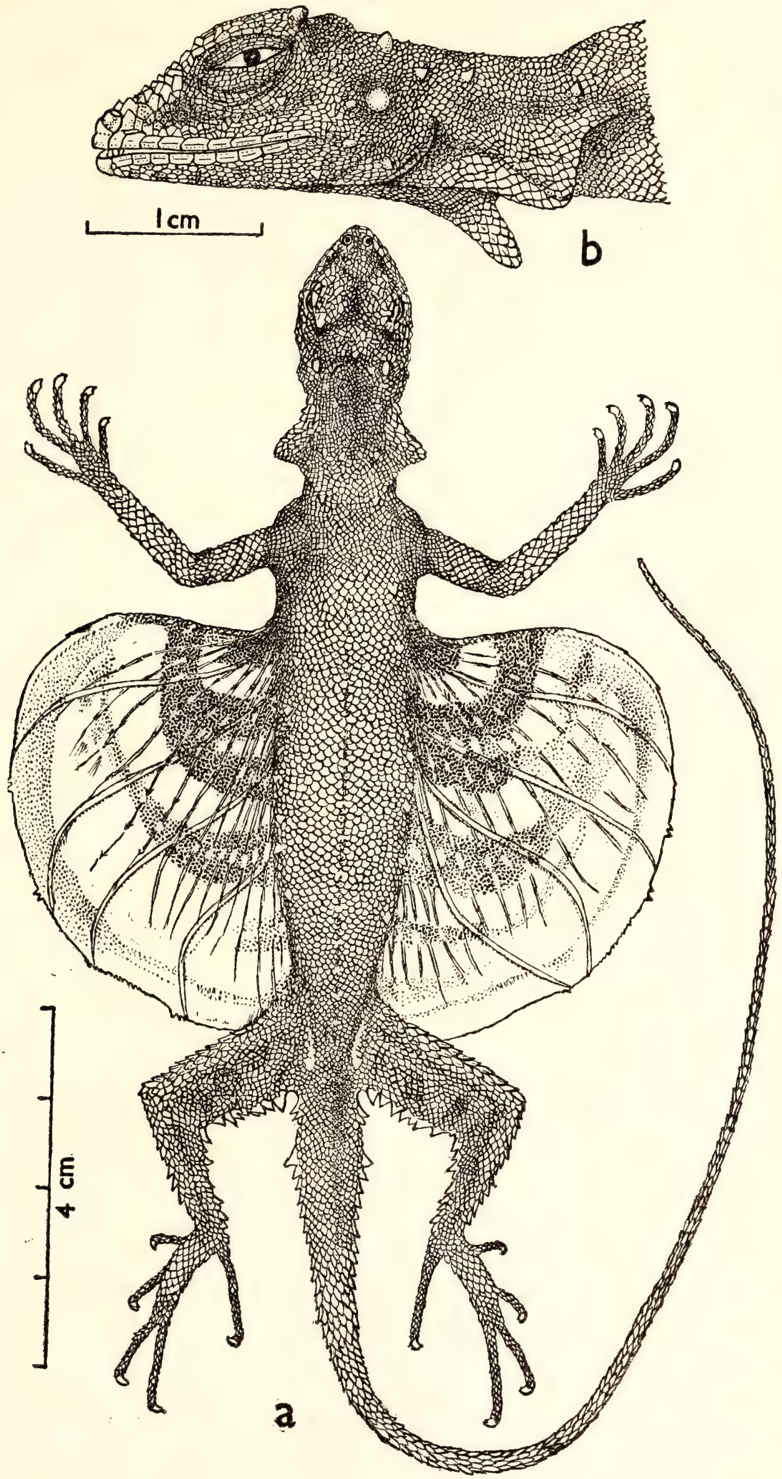
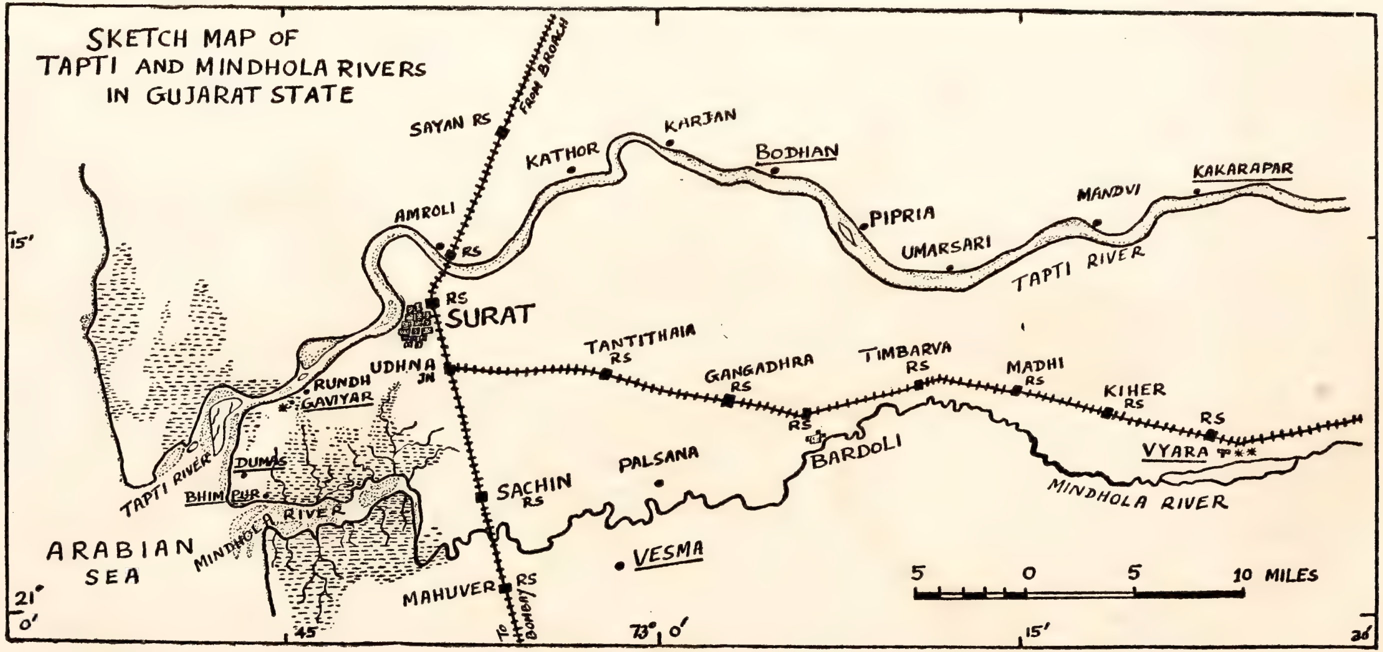
[1] Smith, M. A. (1935): The Fauna of British India (Rept. & Amphi.), Vol. II, Sauria.



Draco blanfordi Boulenger
a. Dorsal view ; *b.* Lateral view of head and neck.


SKETCH MAP OF
TAPTI AND MINDHOLA RIVERS
IN GUJARAT STATE
FROM BROACH
SAYAN RS
KATHOR
KARJAN
BODHAN
PIPRIA
UMARSARI
MANDVI
KAKARAPAR
TAPTI RIVER
AMROLI
RS
RS
SURAT
UDHNA JN
TANTITHAIA RS
GANGADHRA RS
RS
TIMBARVA RS
MADHI RS
KIHER RS
RS
VYARA
BARDOLI
MINDHOLA RIVER
RUNDH
GAVIYAR
DUMAS
BHIMPUR
TAPTI RIVER
MINDHOLA RIVER
SACHIN RS
PALSANA
VESMA
ARABIAN SEA
MAHUVER RS
TO BOMBAY
5
0
5
10 MILES
15'
21° 0'
45
73° 0'
15'
30'

a specimen from the Chieng Rai district in Siam, lat. 20° N., and it probably occurs in Burma in the same latitude; at present it is only known in Tenasserim as far as Dawna Hills'. This record of the species near Imphal further extends its northern distribution limit to lat. 25° N. and the western limit from Burma to Assam.

So far only two species, *D. norvilli* and *D. maculatus* have been recorded from north-east India. The former from Nagaland Hills and Goalpara (Assam) and the latter from north-east India to the whole of Indo-Chinese Peninsula and Hainan, extending south to lat. 8° N. in Thailand. It may be mentioned in passing that the occurrence of a species *D. dussumieri* Dum. & Bib. only in south-west India, provides an interesting case of discontinuous distribution of this eastern and predominantly Malayan genus in peninsular India, separated from its allies in Assam by a wide gap.

Measurements (mm.)

Snout to vent	..	96·00
Tail	..	169·00
Head (snout to lower angle of jaw)	..	10·45
Snout	..	6·20
Breadth of head (near tympanum)	..	10·30
Orbit	..	7·40

I am very grateful to Dr. K. K. Tiwari for his kind help in the preparation of this paper.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA, S. BISWAS
February 2, 1967.

11. ON THE OCCURRENCE AND BREEDING OF *CATLA CATLA* (HAMILTON) IN TAPTI RIVER

(*With a map*)

According to Jones & Sarojini (1952), the natural distribution of *Catla catla* (Hamilton) is from Sind and Punjab in the north along upper India to Krishna River in the south and as far as Burma in the east. Among peninsular rivers, *Catla* is known to occur in Narbada River (Rajan & Kaushik 1958) and Tapti River may therefore be considered within the range of the natural distribution of *Catla*.

But enquiries (during the fishery survey of 1959-60) from fishermen of Tapti River and at fish markets in Madhya Pradesh, Maharashtra and Gujarat States where fish from Tapti is sold indicated that *Catla* does not occur in Tapti River. Since the Tapti becomes extremely shallow in certain stretches during summer months, it cannot be considered a natural and favourable habitat for a large and deep bodied fish like *Catla* (maximum length, at least 6 ft.; Day 1878) which is known to thrive in large and deep rivers. In rare instances, *Catla* occurs in deep pools of small and shallow rivers, which serve as its temporary abode in summer (Setna & Kulkarni 1946). While exploring new fish seed resources in Tapti River during south-west monsoon season from June to September 1961, evidence of occurrence and breeding of *Catla* in a certain section of the Tapti was noticed and are reported in the present note.

Several samples of fish seed collected from a section of Tapti River near Bodhan (Surat District, Gujarat State) from 16-7-1961 to 15-9-1961 were reared in two local seasonal tanks, to ascertain their quality. Examination of fish samples from one of these tanks, after three weeks rearing, revealed the presence of 26 fingerlings (2-3 inches) of *Catla*, which made up 1·1% of the samples. As this seasonal tank was stocked exclusively with Tapti fish seed, these observations showed that the latter included some *Catla* seed and that *Catla* has not only established itself in certain stretches of the Tapti but also successfully breeds upstream of Bodhan during monsoon floods. This evidence is particularly significant in view of the earlier observations regarding non-availability of *Catla* in Tapti River.

The occurrence of *Catla* in the Tapti River reported above appears to be accidental, caused by escape of major carps from the overflooded Vyara Tank into the Mindhola River and thence, during monsoon inundations into the Tapti, the lower reaches of which are reported to get connected with Mindhola (Map). Grown up specimens of *Catla* and Rohu have been reported caught from Gaviar Tank which has no history of stocking with these species. These must be escapes from Vyara Tank trapped during their migration into Tapti through Mindhola. This is thus another instance of *Catla* adapting itself to deep pools in small shallow rivers. If the stock in such situations like the deep pools at the base of Kakarapar Weir is conserved, potential fish seed collection centres could develop along the course of the river.

ACKNOWLEDGEMENTS

The authors are greatly indebted to Dr. B. S. Bhimachar, Director and Dr. V. G. Jhingran, Research Officer, Central Inland Fisheries Research Institute for their valuable suggestions and constant encouragement and to Shri D. L. Dholakia, Assistant Director of Fisheries, Gujarat Fisheries Department for supplying necessary information.

NARBADA-TAPTI UNIT,
CENTRAL INLAND FISHERIES
RESEARCH INSTITUTE[1],
HOSHANGABAD (M.P.),
December 11, 1965.

S. J. KARAMCHANDANI
M. D. PISOLKAR

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12. *KACHAL*, A TACKLE FOR FILE-FISH (FAMILY BALISTIDAE: PISCES)

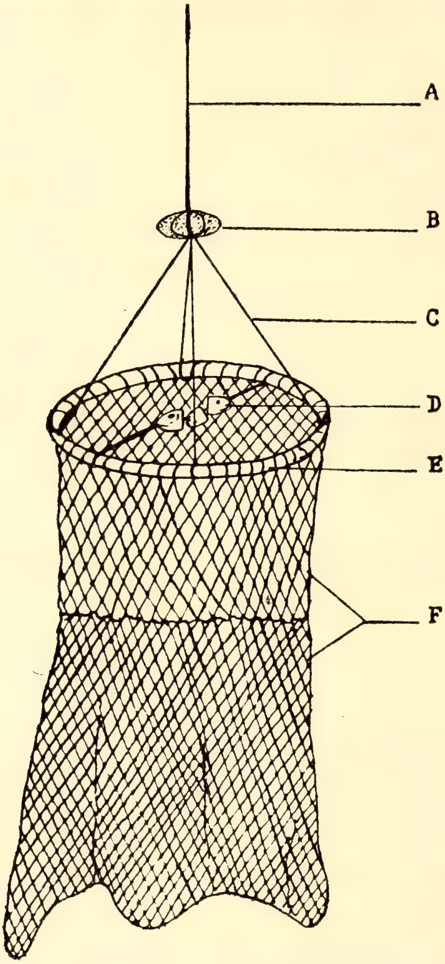
(*With a text-figure*)

To suit local exigencies and conditions several indigenous types of gear have been developed by fishermen from ancient times which though primitive and crude in appearance are efficient in their own way. One such gear is the *Kachal*, used to capture the file-fish (Balistidae) along the south-west coast of India between Muttum and Vizhingam. Since good results are obtained at little cost, the gear is used extensively by fishermen. No information is available about this in any of the published records. Enquiries show that *kachal* has been in use for over 75 years.

The *kachal* consists of a circular frame about 25 cm. in diameter made of coconut leaf stalk and a bag-like net. Three or four finely twisted cotton strings about 50 cm. in length are tied to the frame at equal intervals (Text-figure). The strings are tied together and to a strong coir rope about 100 metres long. A stone sinker weighing about a kilogram is tied where the coir rope joins with the cotton strings. The main part of the gear is a bag of cotton netting about 60 cm. long, consisting of two or three pieces of net (*mal*) joined together. The net is hand-made, the mesh size, when stretched, being 20 mm. throughout. The bag-like net is tied around the circular frame, the mouth portion of the net, which is attached to the frame, being of one piece or *mal*. To the distal end of this is attached the main bag which is considerably wider.

---

[1] Presently C/o. The Deputy Director of Fisheries, Rewa & Jabalpur Division, Madhya Pradesh, Rewa (M.P.).



A. lead rope ; B. sinker ; C. connecting strings ; D. bait ;
E. frame ; F. net.

The *kachal* is operated from a catamaran or a small canoe. One person can operate two units at a time. After selecting a suitable site for operation, advantage is taken of the habit of the file-fish of cutting its food into small bits, to locate file-fish in the area. A hand line with one or two hooks baited with cuttle fish meat is lowered. If the bait is eaten up completely without the fish being caught by the hooks it indicates that the bait has been taken by file-fish.

To start the operation of *kachal*, cuttle fish meat is tied to a string across the mouth of the circular frame. The net is lowered and the mouth of the *kachal* goes down with the bag portion following, because of the weight of the sinker. File-fish attacking the bait, and in line with the mouth enter inside the spread net. When the desired depth is reached the operator stops lowering the rope and the mouth of the *kachal* turns up with file-fish feeding on the bait from within and outside the mouth of the net. The size of the school is felt by the operator through the jerks he gets from the rope. In pulling up the net, the first pull is in the form of a jerk so that all the fish at the mouth will go inside the net. After this, the net is pulled up very quickly allowing little time for the fish to escape. Subsequent operations are made by using skinned file-fish head as bait and more file-fish are caught by using skinned file-fish head than any other bait. It is estimated that during a good season each haul brings on an average of 75 to 100 fish.

The fishing villages between Vizhingam and Muttum in the south-west coast extensively use this gear. The fishing season is approximately four months from December to March. During this period file-fish form a major fishery owing to the paucity of other fishes in the landings. The operating radius for the *kachal* is from seven to ten miles from shore, usually at 60 to 80 metres depth. However, the fishing grounds shift according to the movements of the shoals. Fishing is conducted mainly during day time. Venkataraman & George (1964) recorded concentrations of file-fishes of the species *Odonus niger* and *Sufflamen capistratus* at 50-60 metre depths in the west coast. Among the species of file-fish taken by *kachal* at Vizhingam during 1960 to 1963 the black balistid, *Odonus niger* was the most common followed by *Pseudobalistes fuscus* and *Sufflamen capistratus*. The percentage proportion of file-fish landed at Vizhingam in comparison with those of other fishes is given by Nayar (1958).

CENTRAL MARINE FISHERIES
RESEARCH INSTITUTE,
CALICUT-5,
March 29, 1967.

P. SAM BENNET

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13. THE RUSTY PLUM APHID, *HYSTERONEURA SETARIAE* (THOMAS) IN SOUTHERN INDIA

The Rusty Plum Aphid, *Hysteroneura setariae* (Thomas) has been known for nearly a century from north and south America where it lives on plum trees during autumn as its primary host and on cereals and grasses during summer. During the last decade, Eastop (1954) noted it in north-eastern Africa and Tao (1962) in Hong Kong. It has now been collected in southern India for the first time. Evidently it has been distributed in recent years from the western hemisphere to other parts of the world along with the shipments of grains and other commodities. Some of the important features of the insect are given here.

Diagnostic features. A small, brown aphid with dark cornicles and pale cauda with two pairs of hairs; legs and antennae brown with intermittent white portions; terminal process of the last antennal segment very long. In the winged forms, the hind wing has only one oblique vein instead of the usual two.

Feeding habits. In south India the aphid has been observed to feed on the following plants: *Oryza sativa* (rice), *Sorghum vulgare* (sorghum), *Zea mays* (maize), *Eleusine coracana* (Italian millet or *ragi*), *Bothriochloa insculpta, Cenchrus setigerus, Chloris barbata, Cynodon dactylon, Dacteloctenium aegyptium, Digitaria longiflora, Eragrostis major, Panicum antidotale, Panicum flavidum, Panicum montanum, Pennisetum* sp., *Saccharum spontaneum, Setaria sphacelata* and *Cyperus* sp.

The aphid usually sucks the sap of the plant from the base of the spikelets. On rare occasions it feeds on the stalks of the panicle. It occurs in small colonies on the rachis of the spikelets. Occasionally the black ant, *Camponotus compressus,* is seen to attend on the aphid singly.

It occurs all through the year whenever the grasses put forth earheads, but is scarce in the early part of June on the plains due to the summer heat.

Distribution. The aphid has been noted from Madurai in the south to Anantapur in the north, on the plains as well as on the hills up to Coonoor (5500 feet above mean sea level) on the Nilgiris. The localities in which it has been recorded are Madras, Tambaram, Tindivanam, Coimbatore, Madurai, Bangalore, Anantapur and Coonoor.

It is clear that the aphid has established itself quite well here since it is able to survive during most part of the summer also on the plains. It can cause appreciable damage to cereal crops if it is found in large numbers.

ACKNOWLEDGEMENTS

Thanks are due to Professor K. R. Venkatasubban, Professor of Botany, Madras Christian College, for kindly identifying some of the grasses. This research has been financed in part by a grant made by the United States Department of Agriculture under PL 480.

DEPARTMENT OF ZOOLOGY,
MADRAS CHRISTIAN COLLEGE,
TAMBARAM, MADRAS 59,
February 16, 1967.

S. KANAKARAJ DAVID
S. G. RAJASINGH
K. NARAYANAN

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14. LAKATT AND PAMBU: LEPCHA EXPLORERS

> 'The Oberthür collection (now mostly in the British Museum) contained a large number of butterflies taken by Lakatt and Pamboo in Penang and Perak in 1895 . . . . it is evident that Lakatt and Pamboo were discriminating collectors. Nothing is known about them, but it is believed that they may have been sakai.'
>
> Corbet 1956 : 67.

Through the kindness of the Trustees and Mr. J. P. Doncaster, C.B.E., Keeper of Entomology, the British Museum (Natural History), I have had the opportunity for extensive reading in their Libraries, and the luck to identify these two collectors. From scattered sentences by different authors it is clear that, far from being natives of Malaya, Lakatt and Pambu came from Sikkim. They were members of the famous tribe of Lepchas, the original inhabitants of that country and born naturalists.

The specimen labels are all printed by Oberthür himself and bear the two Lepchas' names, either Penang or Perak, and the date June-August 1895. Corbet (1948: 93, 1956: 479 notes 68, 71) gave good reasons for the belief that, by 'Perak', Oberthür implied Tavoy in peninsular Burma. He may well, as a Frenchman, have used the term loosely for the west coast of the peninsula, in the same way as 'Malacca' was formerly used for all southern Malaya.

The date 1895 suggested a link with William Doherty. This great American traveller and entomologist started butterfly collecting in 1882 when visiting India, and in the course of the next eleven years he toured the whole of the archipelago now embraced by Malaysia and Indonesia. After two years at home he made a second tour of the same area, lasting from December 1895 to 1899. Doherty used to make periodic visits to Calcutta to replenish supplies, and to leave with Lionel de Nicéville at the Indian Museum his articles for the Journals of the Bombay Natural History Society and the Royal Asiatic Society of Bengal, before hurrying off again. Sometimes he would go up to Darjeeling to recruit Lepcha collectors and Indian assistants; sometimes they would rendezvous at Calcutta.

Doherty's last journey ended after only nine months. This time he went to Africa (again via Darjeeling). While camped in Wa Kikuyu territory he became fatally ill, and his Lepchas carried him to the hospital in Nairobi. So W. A. Doherty (15 May 1857-25 May 1901) died within a year of, and even younger than, his friend and colleague C. L. A. de Nicéville (1852-3 December 1901).

In 1889 Doherty collected in Assam and Burma, and Elwes (1891) quoted passages from his letters. He wrote (p. 249) 'I had to go to Darjeeling for my Lepchas and got two fairly good men; I have also two other men . . . and hope to keep them permanently.' He only mentions two of the four by name. Writing from Thandaung where there are four hilltops, he says; (p. 255) 'Each of my men used to take a peak and stay there all day, and Pambu actually made a platform of boughs on the top of a tree and stood on it all day.' Later (p. 258) he mentioned Longchung, who fell ill.

Another of Doherty's friends was Ernst Hartert, the famous ornithologist. They met accidentally in Malaya, corresponded, and Hartert (1901) wrote an informative obituary which included a digest of Doherty's diary. The entries for 1891-93 are relevant:—

1891 (called at Calcutta, then sailed) for Java with four men . .

> . . My Lepchas . . Chedi has cholera . . Tungkyitbo in hospital . . his death at sea . . . Pambu has D.T. . . .
>
> 1892 Amboina . Batchian . Obi . Talaut . Sangir . earthquake . Chedi injured by fall . Timor . Wetter . Kisser . Letti . Dam . Tenimber . Babar . Amboina . Ternate . Halmaheira . Humboldt Bay . Yutafa . Anaphir . Lake Sentani . Pambu gets lost, brought back . Tana Mera Bay . Terfia . Biak . Korrido . Jobi . Yaur . Wandesi . Dorey . Andai . Ron . Jobi.
>
> 1893 Jobi . Ternate . Amboina . Macassar . Surabaya . Singapore . Penang . Calcutta . Ceylon . Europe . New York (July).'

We thus have accounted for Pambu from 1889 to 1893, and placed Longchung in 1889, and Chedi and the ill-fated Tungkyitbo from 1891 to 1893. We have still not located Lakatt.

Oberthür's writings were voluminous, haphazard in sequence, and seldom indexed. But one vital sentence is found. Telling of a pale straw-coloured variety of *Appias nero* Fab., Oberthür (1896: 6) says it was taken in 'Perak, par les chasseurs Lepchas, Lakat et Pamboo, au cours de leur expédition de juillet et août 1895.' While Doherty was at home in America, Lakatt and Pambu seem to have been free-lancing on their own!

de Nicéville and Martin (1896: 361) give a possible clue as to how our Lepchas reached Penang. In prefacing their exhaustive list of Sumatran butterflies they say that in 1893-4 de Nicéville 'induced three amateur collectors in British India to send down to Sumatra some of the well-known Lepcha collectors from Darjiling to Dr. Martin's care'. These may well have included Lakatt, and Doherty's unemployed Pambu. Then, in 1895, on their way home, perhaps the much-travelled Pambu took Lakatt on their independent journey via Penang and Burma, reaching Calcutta in good time to meet Doherty before he left in December 1895.

Thus Doherty quoted by Elwes and by Hartert, Oberthür, de Nicéville and Martin, and Corbet, each contribute isolated remarks from which the identity and some account of the achievements of Lakatt and Pambu can be deduced. The last to be found provides a sad epitaph. Rothschild and Hartert (1901: 59) wrote;

> 'On Jobi (i.e. Japen Is., Geelvink Bay, West Irian; in 1898) Mr. Doherty had the great misfortune to lose Pambu, a Lepcha, whom he calls his right-hand man, who was with him since 1889 and of whom he speaks in the highest terms. Poor Pambu was murdered by savages.'

So passed Pambu, working some 5,000 miles from home. We can picture him a dedicated and enterprising naturalist, a faithful and cheerful companion and a staunch and steady friend.

Lakatt's name has been commemorated in butterfly nomenclature by the Lycaenid *Jamides zebra lakatti* Corbet, 1940 (*Proc. R. ent. Soc. Lond.* (B) **9**: 2). It is hoped shortly to give Pambu similar recognition.

LITTLE GADDESDEN HOUSE,
BERKHAMSTED, HERTS,
ENGLAND,
March 13, 1967.

Lt. Col. C. F. COWAN

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15. A CONTRIBUTION TO THE ROTATORIAN FAUNA OF SOUTH INDIA

(*With two plates*)

INTRODUCTION

Present knowledge of the Rotatorian fauna of the Indian sub-continent is very scanty. Work on stray collections of Rotatoria by Anderson (1899), Murray (1906), Apstein (1907), Stewart (1908), Edmundson & Hutchinson (1934), Hauer (1936, 1937), Donner (1949, 1953), Brehm (1951) and Pasha (1961) have brought to light 161 species of Rotatoria from the Indian sub-continent and Tibet. Till now no one has undertaken a serious and intensive work on this group in India. Consequently several cosmopolitan species are not yet known from the sub-continent. An intensive study on the group is bound to be extremely rewarding.

The present paper lists 12 species, of which 8 are new records for the Indian sub-continent.

MATERIAL AND METHODS

All the species recorded here were collected by the author from two fresh-water wells at Cuddapah and Chittoor and from temporary rain water puddles at Vijayawada. Samples of water were centrifuged to concentrate the rotifers. All the species treated here were studied in living condition and sketches of non-loricate species were drawn from live specimens. The sketches of loricate species were drawn after killing them in formaldehyde.

SYSTEMATIC ENUMERATION

Class MONOGONOTA

Order PLOIMA

Family BRACHIONIDAE

Sub-Family BRACHIONINAE

BRACHIONUS Pallas

Brachionus calyciflorus Pallas, 1776. (Plate I, Fig. 1)

Yamamoto, 1960, p. 389, fig. 8 ; Sudzuki, 1964, p. 100, pl. 6, fig. 1.

Material examined : Single specimen from rain water puddle at Vijayawada on 26-5-63.

Dimensions : Lorica 210μ × 150μ.

Remarks : Recorded from Punjab and Kashmir from north India ; new record for south India.

Brachionus quadridentatus Hermann, 1873. (Plate I, Fig. 2)

Yamamoto, 1960, p. 371, fig. 9 ; Sudzuki, 1964, p. 103, pl. 9, fig. 9, 10.

Material examined : One specimen from ditch water at Vijayawada on 28-5-63.

Dimensions : Lorica 185μ × 150μ.

Remarks : New record for the Indian sub-continent.

Brachionus urceolaris var. **urawensis** Sudzuki, 1964. (Plate I, Fig. 3).

Material examined : Three specimens from a temporary rain water puddle at Vijayawada on 16-5-63.

Dimensions : Lorica 210-241μ × 150-180μ.

Remarks : New to the Indian sub-continent. Known only from Japan till now (Sudzuki, 1964).

Brachionus sp. (Plate I, Fig. 4)

Material examined : Two specimens from ditch water at Vijayawada on 26-5-63.

Dimensions : Lorica 165-175$\mu \times$ 140-145μ.

Remarks : This form does not agree with known species of *Brachionus.* Possibly a new species but more specimens of this form will have to be studied before assigning to it the status of a new species.

MACROCHAETUS Perty

Macrochaetus subquadratus (Perty, 1850), (Plate II, Fig. 5)

Gillard, 1952, p. 329, fig. 3 ; Edmundson, 1959, p. 450, figs. 18-25 (a).

Material examined : Several specimens among filamentous algae of fresh-water at Cuddapah on 6-12-58.

Dimensions : Lorica 74$\mu \times$ 81μ.

Remarks : New record for the Indian sub-continent.

Sub-Family COLURINAE

LAPADELLA Bory de St. Vincent.

Lapadella dactyliseta (Stenroos) (Plate II, Fig. 6)

Hauer, 1935, pp. 87-88, fig. 19.

Material examined : Several specimens among algae of an old well at Chittoor in August 1964.

Dimensions : Lorica 83-90$\mu \times$ 55-60μ.

Remarks : New record for the Indian sub-continent.

Lapadella similis Lucks. (Plate II, Fig. 7)

Hauer, 1935, p. 144, pl. I, fig. 5.

Material examined : Several specimens among filamentous algae of an unused well at Cuddapah on 9-9-61.

Dimensions : Lorica 96-100$\mu \times$ 65-67μ.

Remarks : New record for the Indian sub-continent.

Family LECANIDAE

LECANE Nitzsch.

Lecane papuana (Murray). (Plate II, Fig. 8)

Pasha, 1961, p. 50-51, fig. 1, 2.

Material examined : Several specimens among filamentous algae from a well at Cuddapah on 22-1-61.

Dimensions : Lorica 138-150$\mu \times$ 108-113μ.

Remarks : Recorded from Madras (S. India) ; Punjab (N. India)

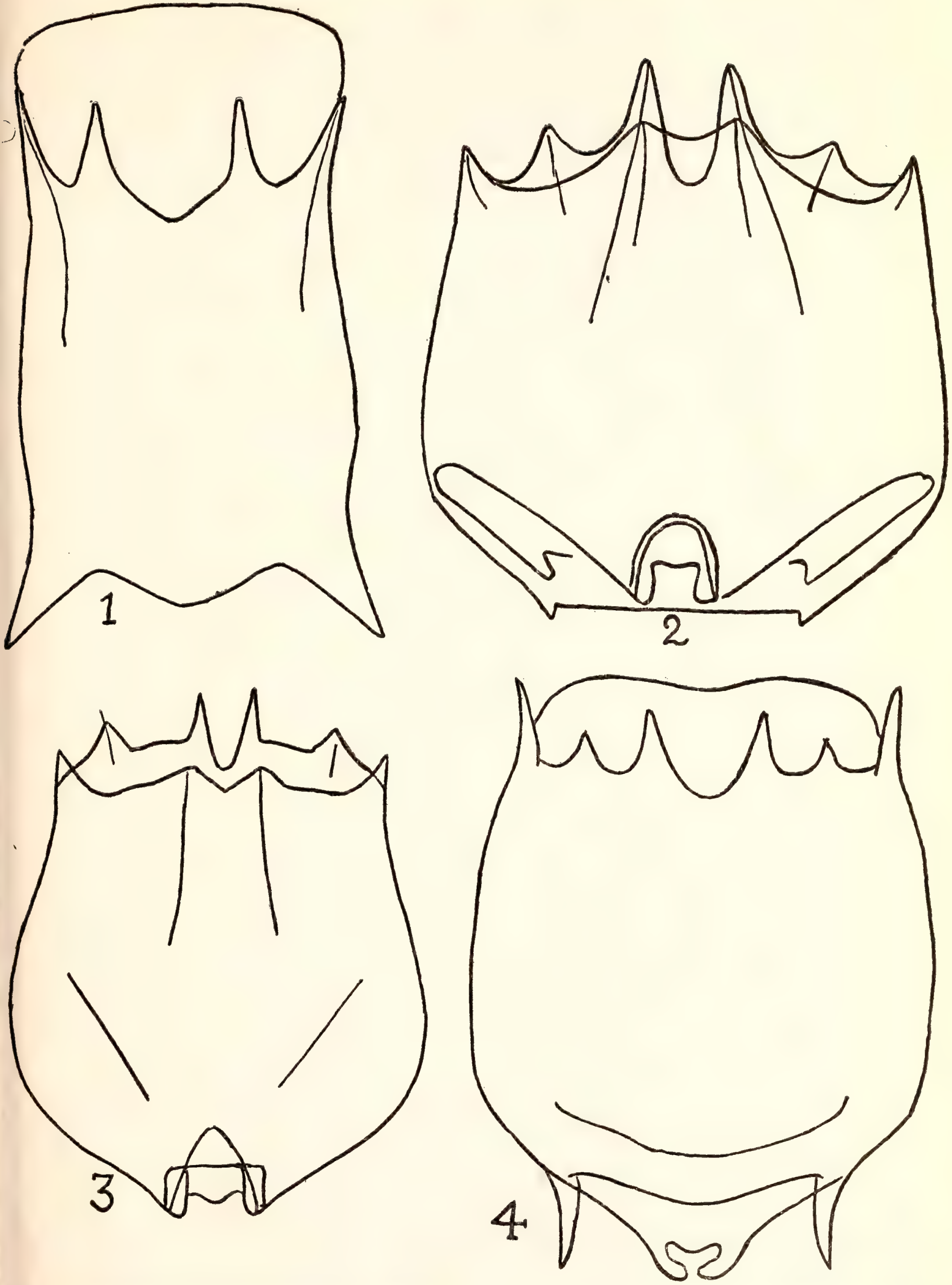

Fig. 1. *Brachionus calyciflorus* × *c*. 338; Fig. 2. *B. quadridentatus* × *c*. 414; Fig. 3. *B. urceolaris* var. *urawensis* × *c*. 326; Fig. 4. *Brachionus* sp. × *c*. 720.

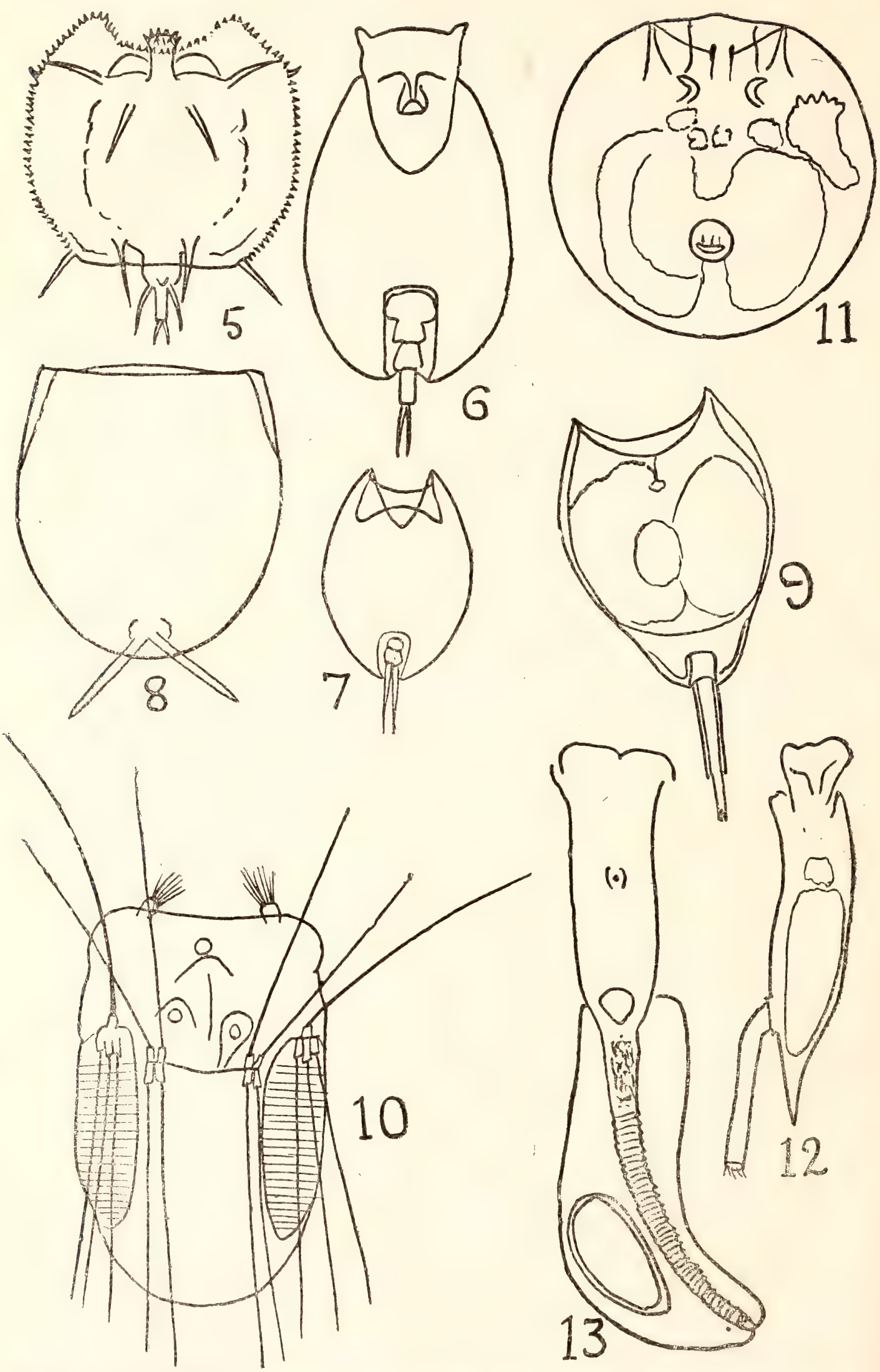

Fig. 5. *Macrochaetus subquadratus* × *c*. 400; Fig. 6. *Lapadella dactyliseta* × *c*. 426; Fig. 7. *L. similis* × *c*. 306; Fig. 8. *Lecane papuana* × *c*. 296; Fig. 9. *Monostyla lunaris* × *c*. 289; Fig. 10. *Polyarthra longiremis* × *c*. 355; Fig. 11. *Testudinella patina* × *c*. 355; Fig. 12. *T. patina* × *c*. 222; Fig. 13. *Ptygura* sp. × *c*. 231.

MONOSTYLA Ehrenberg.

Monostyla lunaris Ehrenberg. (Plate II, Fig. 9)

Edmundson & Hutchinson, 1934, p. 160; Hauer, 1935, p. 95.

Material examined: Several specimens among filamentous algae collected from an old well at Cuddapah during June 1961.

Dimensions: Lorica 132-136$\mu \times$ 97-100μ.

Remarks: Reported from Kashmir and Ladakh. New record for south India.

Family SYNCHAETIDAE

POLYARTHRA Ehrenberg.

Polyarthra longiremis Carlin, 1943. (Plate II, Fig. 10)

Bartos, 1951, pp. 86-87, fig. 6.

Material examined: Three specimens from ditch water at Vijayawada on 18-5-63.

Dimensions: 135-140$\mu \times$ 90-92μ.

Remarks: New record for the Indian sub-continent.

Order FLOSCULARIACEAE

Family TESTUDINELLIDAE

TESTUDINELLA Bory de St. Vincent.

Testudinella patina (Hermann, 1783). (Plate II, Figs. 11-12)

Edmundson, & Hutchinson, 1934, p. 161; Gillard, 1947, pp. 154-155, fig. 2; Edmundson 1959, p. 473, figs. 18-90 (a).

Material examined: Several specimens among filamentous algae at Cuddapah in 1961 and at Chittoor in August 1964 and February 1965.

Dimensions: Lorica 116-122$\mu \times$ 119-124μ.

Remarks: Recorded from Calcutta, Punjab and Kashmir. New record for south India.

Family FLOSCULARIIDAE

PTYGURA Ehrenberg.

Ptygura sp. (Plate II, Fig. 13)

Material examined: Single specimen attached to filamentous alga from an old well at Cuddapah on 12-8-61.

Dimensions : Foot 175μ long, 19$\mu\times$10μ wide at apex and base respectively ; body 160$\mu\times$46μ ; corona 66μ ; tube 195$\mu\times$60μ. Peduncle very short.

ACKNOWLEDGEMENT

The author is extremely thankful to Sri S. M. Kamal Pasha of Presidency College, Madras, for making available the literature on the Rotatoria, which enabled the preparation of this paper.

DEPARTMENT OF ZOOLOGY,
GOVT. ARTS AND SCIENCE COLLEGE,
CHITOOR, A. P.,
May 8, 1965.

K. VANAMALA NAIDU

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16. A NEW COMBINATION IN *TOURNEFORTIA* LINN. (BORAGINACEAE)

In this paper the author has made a new combination, *Tournefortia subtropica* (Clarke) Ban. comb. et stat. nov. This taxon is restricted to the Eastern Himalayas.

It is similar to *T. hookeri* Clarke in vegetative characters but the size of the corolla is much larger, usually more than thrice the length of the calyx, and the corolla unlike that of *T. hookeri* is pentagonal with 5 hairy lines outside. So I am raising the status of the taxon to a species. The synonymy is given below:

Tournefortia subtropica (Clarke) Ban. comb. et stat. nov. *T. hookeri* Clarke var. *subtropica* Clarke in Hook. f. Fl. Brit. Ind. 4: 147 (1883).

I wish to express my gratitude to Dr. S. K. Mukerjee, Keeper, Central National Herbarium, Botanical Survey of India, for his valuable suggestions.

Botanical Survey of India,
Calcutta,
October 17, 1966

S. P. BANERJEE

17. *LIMNOCHARIS* H.B.K. : A GENUS NEW TO INDIA

During a recent visit to Kerala by one of us (R. V. K.), an interesting water plant was collected at Ambalapuzha. It was identified at CAL as *Limnocharis flava* (L.) Buchenau (Butomaceae). Previous literature showed that this genus has not been reported so far from India.

Limnocharis H.B.K. Pl. Aequin. 1: 116, 1807.

Limnocharis flava (L.) Buchenau in Abh. Naturw. Ver. Bremen 2: 2, 1868 & in Pflanzenreich 16: 9, f. 4, 1903, incl. var. *indica* Buchenau; Biswas & Calder, Handb. Water & Marsh Pl. Ind. Burm. 80, 1937; Senaratna in Trop. Agric. 94: 362, 1940 & in Ceylon J. Sc. (A. Bot.) 12: 164, 1945; van Steenis in Fl. Males. I, 5: 120, 1954. *Alisma flava* L. Sp. Pl. 343, 1753.

For a detailed description of the species see van Steenis loc. cit.

This species may be mistaken for *Limnophyton obtusifolium* (L.) Miq. at first sight, but can be easily distinguished from the latter as follows:

Leaves broadly sagittate. Flowers white; peduncles and pedicels slender; stamens 6. Fruit an aggregate of obovate achenes; seeds smooth ...	*Limnophyton obtusifolium*
Leaves ovate to broadly elliptic or suborbicular. Flowers pale yellow; peduncles and pedicels stout; stamens many, the outer often sterile. Fruit an aggregate of semicircular follicles; seeds with fimbriate transverse ridges ...	*Limnocharis flava*

Specimens examined. Kerala. Alleppey Dt.: Alleppey, 30-10-1961, *Ramachandran s.n.* (CAL); Ambalapuzha, 5-2-1967, *Kammathy 64* (CAL).

Distribution. Probably monotypic. Native of tropical and subtropical America, introduced to south-east Asia (Siam, Burma and Ceylon) and Malaysia; it has probably entered S. India from Ceylon.

Habitat. Grows occasionally along the margins of canals, rooted in mud amidst *Colocasia*, *Monochoria*, and other floating aquatics especially *Salvinia*.

Vegetative reproduction takes place by the formation of small plants on older peduncles; later these plants develop roots and get detached.

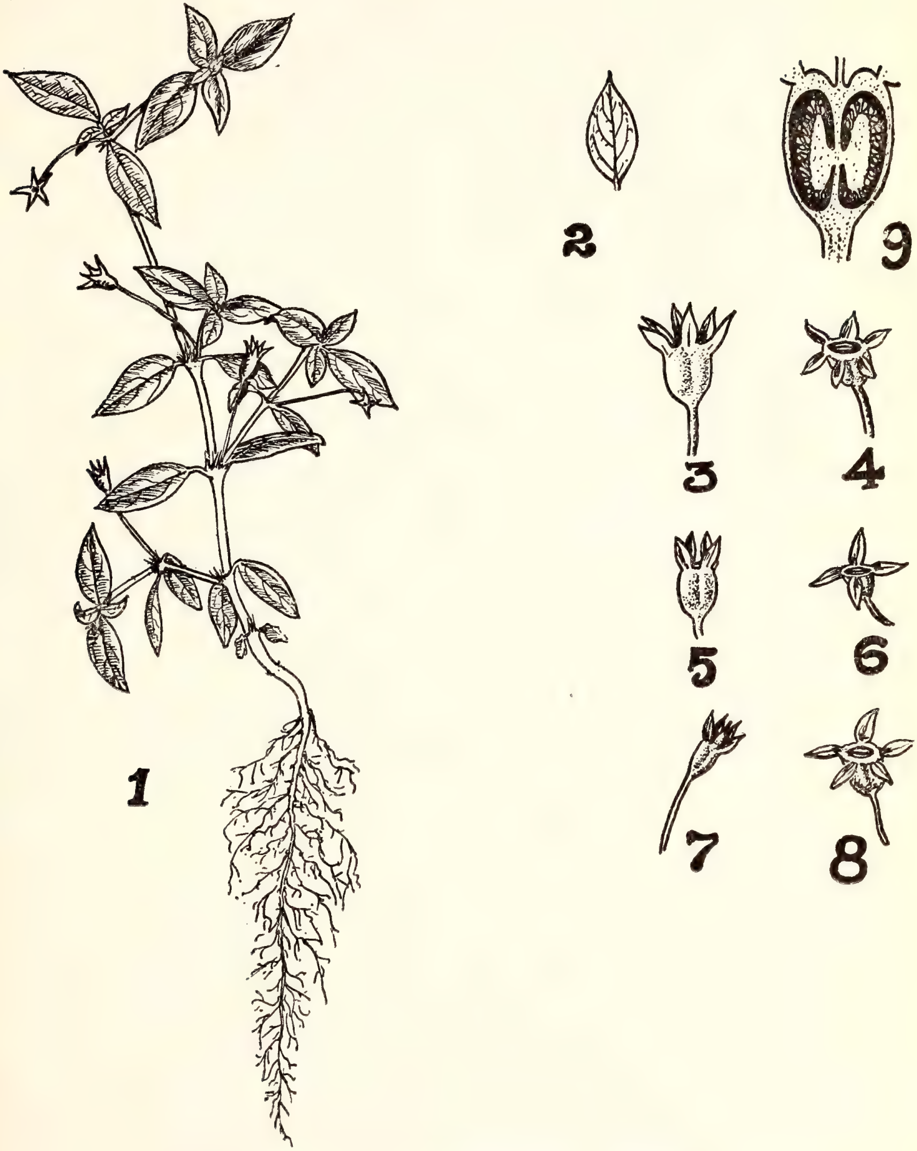
Botanical Survey of India,
Calcutta-14,
March 7, 1967.

R. V. KAMMATHY
K. SUBRAMANYAM

18. *OLDENLANDIA MAHESHWARII* SANT. & MERCH.: A NEW RECORD FOR ANNAMALAINAGAR, MADRAS STATE

(*With a plate*)

The authors collected during the rainy season a species of *Oldenlandia* which differs from all the species described by Gamble. The general characters of this species agree with the description given for *Oldenlandia maheshwarii* Sant. & Merch. but show some minor differences.



Oldenlandia maheshwarii Sant. & Merch.

Fig. 1. Entire plant; Fig. 2. A leaf; Figs. 3 & 4. Fruit with 6 calyx lobes; Figs. 5 & 6. Fruit with 4 calyx lobes; Figs. 7 & 8. Fruit with 5 calyx lobes; Fig. 9. Longitudinal section of the ovary showing the axile placentation with numerous ovules.

The plant is an erect herb, usually 9-12 cm. tall. Leaves are sessile to subsessile with a cuneate base, linear, elliptic, sometimes oblong with an acute apex and tipped with a fine bristle (Figs. 1 & 2). Stipules are membraneous with a broad base and with a few fine filiform bristles (Fig. 1). Flowers are pedicellate, solitary, axillary (Fig. 1), the pedicels are 1-3 cm long, slender and scabrid. Calyx lobes 4-6 in number (Plate, Figs. 3 to 8), ovate to oblong, entire with pubescent hairs on both sides. Corolla white with 4-6 lobes. Stamens are as many as the corolla lobes and are inserted at the throat of the corolla tube. Capsules 1-3 mm. broad, compressed and are crowned with the calyx teeth. Ovules are numerous and are attached to fleshy axile placentae (Fig. 9).

As far as the authors are aware, *Oldenlandia maheshwarii* Sant. & Merch. is reported for the first time from Madras State.

One of us (S.R.) is thankful to the Council of Scientific and Industrial Research for awarding him a Senior Research Fellowship.

TAXONOMY LABORATORY,
BOTANY DEPARTMENT,
ANNAMALAI UNIVERSITY,
ANNAMALAINAGAR,
December 20, 1966.

K. RANGASWAMI AYYANGAR
S. RAMARETHINAM
V. DHANAMJAYAMOORTHY

19. *MYRIOPHYLLUM TUBERCULATUM* ROXB: NEW RECORD FROM KERALA STATE, S. INDIA

(*With a plate*)

Myriophyllum tuberculatum Roxb. common in Bengal has been recorded from Assam, Orissa, and Mysore but, as far as we know, not from Kerala.

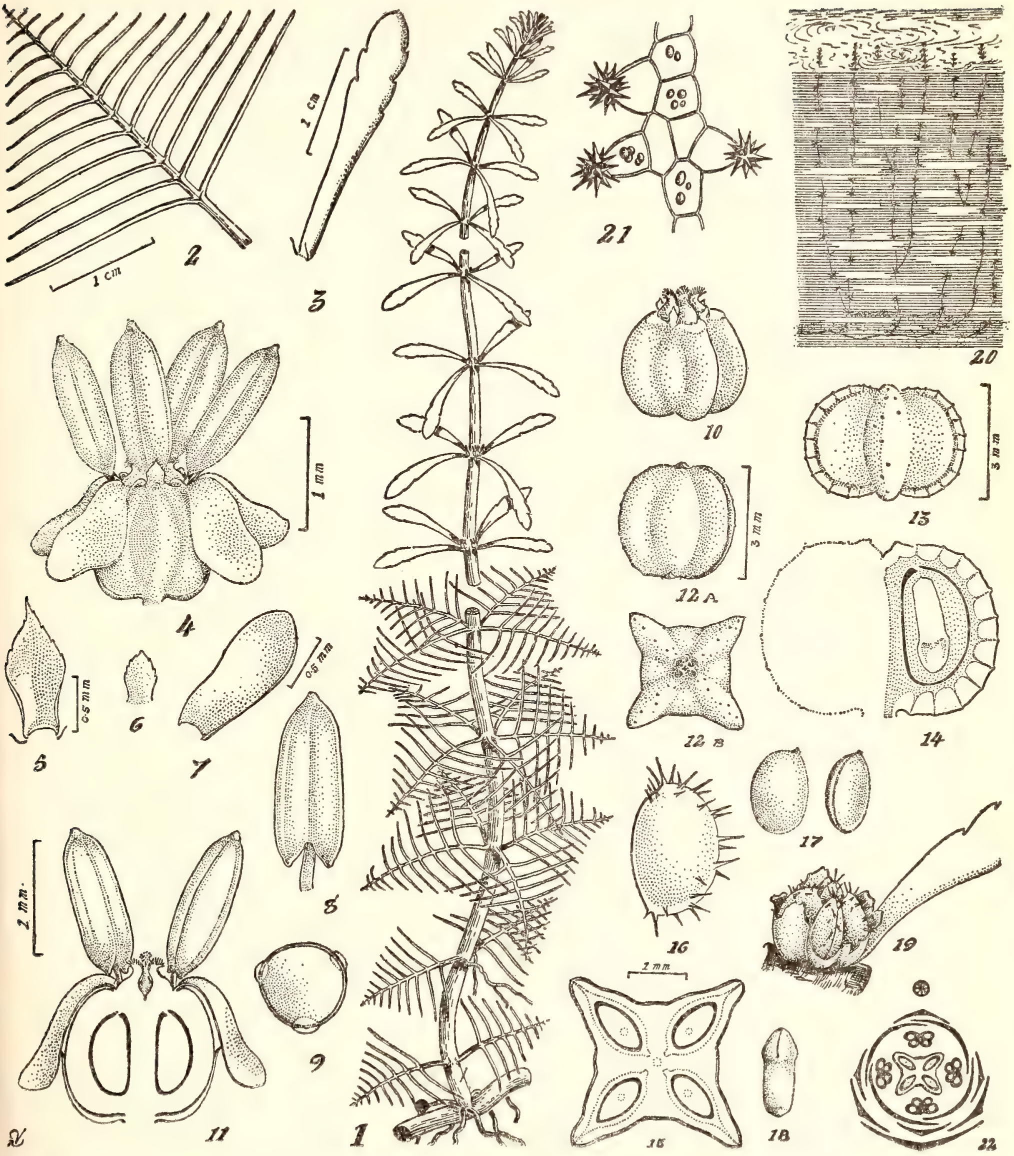
Two good specimens of this species were first collected from a freshwater pond at Alwaye, Kerala, in August 1963, growing in association with species of *Nymphaea*, *Nymphoides*, *Eriocaulon* and the rare *Hydrolithrum*. Again in February 1965, these plants were found in another freshwater pond, a few miles to the west of Alwaye and in similar association. Specimens from both localities were studied in fresh condition. Detailed sketches and description based on fresh specimens are given below, mentioning variations observed.

Myriophyllum tuberculatum Roxb. (Plate, Figs. 1-22)

Submerged, glabrous, heterophyllous annual, 10-60 cm. tall, with base creeping and rooted at nodes and vertical branches having apex above water (Fig. 20). When pond dries up in summer, exposed plants become procumbent, with little or no heterophylly. *Stem* cylindrical, 10-60 cm. tall, 3-5 mm. thick, glabrous, pinkish, freely branching. *Leaves* of two types, in whorls of 3-6, or opposite or sub-opposite towards base and apex of branches or even alternate, as on reduced branches of exposed plants. Submerged leaves green, triangular, pectinate-pinnatifid, *c.* 3 cm. long, with filiform, opposite lobes, basal and longest of which are *c.* 2 cm. long, progressively shorter, arranged 2-3 mm. apart on a narrow, ventrally grooved median part continuing down as indistinct petiole (Fig. 2). Aerial leaves less than 2·5 cm. long, 2-3 mm. broad, linear-spathulate, sessile, distal margins minutely dentate, apex acute; apex and teeth ending in minute, dark points (Fig. 3). *Flowers* solitary, axillary, sub-sessile, bracteolate, pink, 2·5-3 mm. long, tetramerous, hermaphrodite, epigynous (Fig. 4). Bracteoles two, lateral, 1-1·5 mm. long, white, boatlike, acuminate, margins toothed (Fig. 5). *Calyx* polysepalous, of 4 very small, ovate, acute, erect, valvate sepals with minutely toothed margins (Fig. 6). *Corolla* polypetalous, of 4 obovate, concave, pink petals *c.* 1·5 mm. long, with rounded apex and twisted aestivation (Fig. 7). *Androecium* of 4 free, erect stamens *c.* 1·5 mm. long; filaments very short, slender; anthers pink, elongated, two-lobed, four-celled, acute, shortly conical at base, introrse (Fig. 8). *Pollen* white, minute, spherical, smooth, thin-walled, with three circular, convex germ-pores (Fig. 9). *Ovary* inferior, four-angled, four-celled; angles keeled; ovule single, anatropous, with dorsal raphe, pendulous from axile placenta, at the top in each cell (Fig. 11). *Styles* 4, free, short, thick, fleshy with bulbous base, pinkish, ending in fimbriated pink stigma (Fig. 10). *Fruit* stellately 4-keeled, sub-sessile drupe, 3 mm. long, nearly equally broad, with minute warty projections on the keels and sides, pinkish, drying into pale brown; often with dry bracteoles persisting at base (Fig. 12). Fruits when seen against light, show spiny projections of endocarp ending inside the warty projections on surface (Fig. 13). Mature fruit splitting into 4, one-seeded pyrenes, by irregular rupture and decay of fleshy epicarp (Fig. 19). *Pyrene* elliptic, convex, with sharp spinules radiating from outer margins; pale brown (Fig. 16). *Seed* ovate-lenticular, dull-coloured, 1·5 × 1 mm., with very short, stump-like funicle, and dorsal raphe as thin purplish line (Fig. 17). *Testa* transparent, membraneous

J. Bombay nat. Hist. Soc 64 (2)

Vasudevan: *Myriophyllum tuberculatum* Roxb.


2
1 cm
3
1 cm
21
20
4
1 mm
10
13
3 mm
12 A
3 mm
5
0·5 mm
6
7
0·5 mm
12 B
14
8
16
17
2 mm
11
9
1
2 mm
15
18
19
22

Myriophyllum tuberculatum Roxb.

1. Plant; 2. Submerged leaf; 3. Aerial leaf; 4. Flower; 5. Bracteole; 6. Sepal; 7. Petal; 8. Stamen; 9. Pollen; 10. Pistil; 11. Vertical section of flower; 12. Fruit: A. side view, B. top view; 13. Fruit seen against light; 14. Vertical section of fruit; 15. Cross section of fruit; 16. Pyrene; 17. Seeds; 18. Embryo; 19. Fruit, splitting; 20. Habit (diagrammatic); 21. Druses; 22. Floral diagram.

endosperm white; embryo straight; cotyledons two, fleshy, short, with rounded apex; radicle obtuse (Fig. 18).

A striking anatomical character is the presence of plenty of druses, carried by specialised cells. From all around the wall of the air canals in the stem project large conical cells, each with a druse embedded in the wall at the top (Fig. 21).

Another peculiar character, not mentioned by C. B. Clarke in Hooker's FLORA OF BRITISH INDIA or by other authors in India, is the invariable presence of two small, subulate, purple, stipule-like lateral outgrowths at the base of leaves and bracteoles. It is difficult to ascertain their morphological nature from position alone, because similar but extremely minute outgrowths are seen in the notch of the teeth on the leaf-margins. Moreover, similar but less conspicuous outgrowths present at the leaf base of other aquatic plants, e.g. species of *Rotala, Ammania*, etc., are not treated as stipules.

COMMENTS

In two important characters, the plants differed from the short account in FLORA OF BRITISH INDIA (Vol. **2**: p. 432) wherein the plants are stated to be polygamous. But all the plants we examined had only hermaphrodite flowers. Stamens were invariably four in number.

First spot of collection was a large, shallow pond, on a low hill. Soil was of reddish clayey type common in Malabar coast. Plants were in about 2 feet of water, in a crowd of other aquatics.

Second spot of collection was almost at sea-level. Soil was greyish, sandy-loam with preponderance of clay. Though restricted to one spot, plants were more abundant; probably because of more open nature of the association, which consisted of same species at both places.

The plants appeared only after the heavy rains of SW. monsoon. At the second spot, pond being shallow, margins were exposed after the rainy season; and, in February, plants were found procumbent on wet soil with plenty of flowers and fruit.

Normal growth-season of this plant appears to be from August to February.

ACKNOWLEDGEMENT

We are very thankful to the Keeper, Central National Herbarium, Calcutta, for confirming our identification of the species.

GOVT. VICTORIA COLLEGE,
PALGHAT, KERALA,
September 25, 1965.

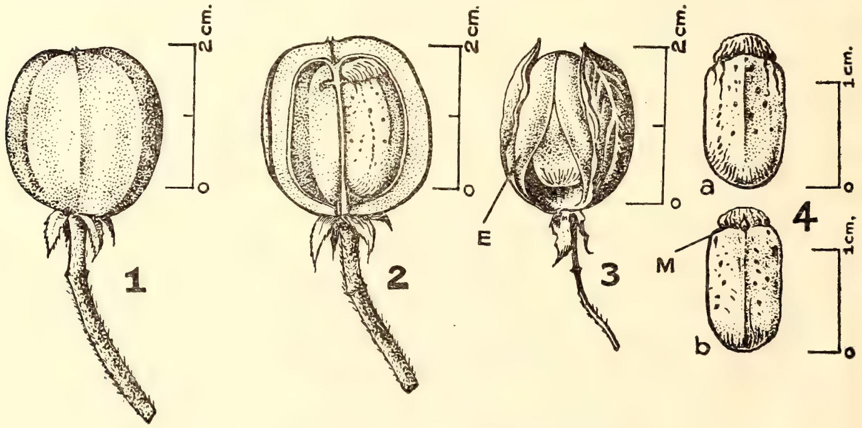
R. VASUDEVAN
K. KESAVAN NAIR

20. FRUIT OF *JATROPHA TANJORENSIS* ELLIS ET SAROJA

(*With a text-figure*)

In an earlier note entitled, 'A new species of *Jatropha* from south India' (*J. Bombay nat. Hist. Soc.* **58**: 834-836, 1961), the description of the fruit of this new species could not be given, for the plant was not collected in fruit. Since then the plant has been collected from various localities, viz., Ramnad Dt., Tiruchirapalli Dt., South Arcot Dt., of Madras State, and a report of its occurrence in West Bengal in Howrah Dt., has recently been given by S. S. R. Bennet (*J. Bombay nat. Hist. Soc.* **62**: 329, 1965).

A live plant collected from one of these localities in south India and planted in the compound of the office of the Southern Circle,



Jatropha tanjorensis Ellis et Saroja

1. Mature fruit; 2. Section of a fruit showing the developed seed; 3. A dried fruit showing loculicidal dehiscence, E—endocarp; 4. Seed—*a.* back view. *b.* front view (M—micropyle).

Botanical Survey of India, Coimbatore, has set fruit, the description of which is given below.

Fruit ± 2·0×1·5 cm., a peduncled, loculicidal, obovoid-oblong, trilocular capsule, with only one ovule of the single locule developing into a seed; the other two abortive. Mature seed oblong-ovoid, pale green with a few deep pink spots all over; dark brown when dry. Caruncle striated, conspicuous. Calyx lobes slightly accrescent as the fruit ripens. Pedicel and peduncle pubescent (Text-figure).

Herbarium specimens examined: Ellis 13850, (18-1-1962): *Ellis 24386,* (12-11-1966).

SOUTHERN CIRCLE,
BOTANICAL SURVEY OF INDIA,
COIMBATORE-2
November 24, 1966.

J. L. ELLIS

21. A NOTE ON *MICHOLITZIA OBCORDATA* N. E. BROWN: ASCLEPIADACEAE

The monotypic genus *Micholitzia* with *M. obcordata* was described by Brown (1909) from a living plant cultivated in the Royal Botanic Gardens, Glasnevin, Dublin. The plant was obtained from Messrs. Sander & Sons of St. Albans, who are stated to have received it from Micholitz when he was collecting in India and Burma. The exact locality of Micholitz's specimen remained a matter of speculation. A year later Craib (1910) discovered another specimen collected by Meebold from Laimatak, Manipur, at an altitude of 1200 m. and suggested that Micholitz's plant probably came from India. The plant was subsequently illustrated in Hooker's ICONES PLANTARUM (1913). After a gap of about 40 years Deb (1955) collected this species as an epiphyte on *Ficus glomerata* Roxb. from Litan, in Manipur region, at an altitude of 915 m. and also saw a specimen collected from Umsaw, Assam. He mistook these specimens for a new species and described it as *Hoya manipurensis.* Later discovering the mistake, he cited this species under its correct name reducing the binomial *Hoya manipurensis* to its synonymy (Deb, 1961). This, nevertheless, confirmed the occurrence of this species in the region of Assam and Manipur.

Although the genus with its single species has been described in detail, the fruit and seed characters have remained unknown. The writer recently found mature fruits and seeds in specimens collected from Manipur by a botanical party of this Institute. These are described. Our specimens have been matched with Meebold's sheet lodged in Calcutta Herbarium.

Micholitzia N. E. Brown in Kew Bull. 1909: 358-59, 1909.

Micholitzia obcordata N. E. Brown in Kew Bull. 1909: 358-59, 1909; Craib, ibid. 1910: 201, 1910: Brown in Hooker's Ic. Pl. IV Ser. 4, 10: *t 2980*, 1913; Deb in Bull. bot. Surv. India. 3: 309, 1961, *Hoya manipurensis* Deb in J. Indian bot. Soc. 34: 50-52, 1955.

Fruit of two follicles; peduncle 3-3·5 mm. long, striate, villously hairy; calyx persistent; follicles widely divergent, straight or slightly curved, linear, cylindrical, gradually tapering from near the middle to a blunt point, 40-65 mm. × 2-3 mm. (width taken in the region below the middle), striate, sparsely pubescent, somewhat everted after dehiscence exposing shining, glabrous inner surface. Seeds oblong, slightly beaked, pointed at the base, 4-4·5 × 1 mm., compressed, glabrous, dark brown, crowned with a thick coma, hairs of the coma *c*. 25 mm. long, silky white.

Sheets examined: Laimatak, Manipur, 1219 m., Nov. 1907, fl., *Meebold 6732*, sheet no. 292613 (CAL); Kangchup Forest, 16 km. from Imphal, Manipur, 19-4-1962, fr., *J. G. Srivastava & Party 81665*, sheet nos. 55939 & 55940 (LWG).

The writer is indebted to the Director, National Botanic Garden Lucknow, for providing the facilities and to Dr. J. K. Maheshwari for going through the manuscript. He is grateful to the Director, Botanical Survey of India, for allowing him to consult the Central National Herbarium, Sibpore.

NATIONAL BOTANIC GARDENS,
LUCKNOW,
January 6, 1967.

S. L. KAPOOR

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DEB, D. B. (1955): A new species of *Hoya* from Manipur. *J. Indian bot. Soc.* **34** : 50-52.

——— (1961): Dicotyledonous plants of Manipur Territory. *Bull. bot. Surv. India.* **3** : 309.

22. CYANOPHYCEAE OF AHMEDABAD

In this note, forty-four taxa belonging to the Cyanophyceae have been recorded for the first time from Ahmedabad and near-by places, such as Sarkhej, Bareja, Vatva, Sanand, and Barejadi. The collections were made during the period June 1955 to May 1956.

1. **Microcystis aeruginosa** Kuetz.

Planktonic in Kankaria tank, Ahmedabad ; in a tank at Sarkhej (throughout the year).

2. **M. flos-aquae** (Witt.) Kirch.

Along with *M. aeruginosa* in Kankaria tank, Ahmedabad (September-November).

3. **M. viridis** (A. Braun) Lemm.

Planktonic in a tank, Sarkhej (10-2-56).

4. **Aphanocapsa koordersi** Strom.

Planktonic in a small cement tank, Sarkhej (28-8-55).

5. **A. muscicola** (Men.) Wille.

Dark green mass on the bark of *Salvadora* sp., Sarkhej (28-8-55).

6. **A. pulchra** (Kuetz.) Rab.

In a pond near Chandola Lake, Ahmedabad (22-2-56).

7. **A. roseana** de Bary

In a paddy field, Sarkhej (9-10-55). Floating in a puddle near Chandola Lake, Ahmedabad (20-11-55).

8. **Aphanothece castagnei** (Breb.) Rab.

Submerged under water in a cement tank, Ahmedabad (28-8-55).

9. **A. microscopica** Naeg.

Floating in a small cement tank, Ahmedabad (2-7-55). In Chandola Lake, Ahmedabad (11-10-55). In a pond, Bareja (28-1-56). On iron pipe, Ahmedabad (28-3-56).

10. **A. naegelii** Wartm.

On moist soil, Ahmedabad (20-11-55).

11. **A. pallida** (Kuetz.) Rab.

Common. On moist soils, tree trunks, in puddles, pools, and ponds (July to October).

12. **A. stagnina** (Spreng.) A. Braun

Floating in a pond near Chandola Lake, Ahmedabad (20-11-55). On moist soil under a bridge, Bareja (15-4-56).

13. **Gloeothece palea** (Kuetz.) Rab.

In a small tank, Ahmedabad (10-8-55).

14. **Chroococcus minutus** (Kuetz.) Naeg.

In a puddle near a streamlet, Vatva (23-10-55).

15. **C. turicensis** (Naeg.) Hansg.

Floating along with other algae in a cement reservoir, Victoria Garden, Ahmedabad (19-6-55).

16. **Merismopedia punctata** Meyen

Common. In puddles, ponds, lakes (August-May).

17. **Gomphosphaeria aponina** Kuetz.

In cement tank, Victoria Garden, Ahmedabad (19-6-55).

18. **Stichosiphon sansibaricus** (Hieron.) Drouet et Daily

Epiphytic on floating algae in a puddle, Bareja (15-4-56).

19. **Microchaete uberrima** Cart.

In a tank, Sarkhej (14-12-55).

20. **Aulosira fertilissima** Ghose v. **tenuis** C. B. Rao

Common. Floating in paddy fields, puddles, ponds (October-December).

21. **Calothrix fusca** Born. et Flah.

Epiphytic on aquatic plants floating or submerged in a pond, Sarkhej (4-12-55).

22. **C. karnatakensis** v. **major** Gonz. et Kam.

In mucilaginous mass of *Gloeotrichia* sp. floating in a pond, Ahmedabad (20-11-55).

23. **C. wemberensis** Hieron. et Schmidle

Epiphytic on *Rhizoclonium* sp. floating in a pool, Bareja (15-4-56).

24. **Gloeotrichia raciborskii** Wol. v. **lilienfeldiana** Geitler

In ponds, Sarkhej (9-10-55), Barejadi (20-10-55).

25. **Tolypothrix byssoidea** (Hass.) Kirch.

On the bark of *Salvadora* sp., Vatva (10-8-55). On the bark of *Tamarindus* sp., *Feronia* sp., Ahmedabad (15-8-55).

26. **Scytonema ocellatum** Lyng.

On the bark of *Tamarindus* sp., Ahmedabad (10-8-55). On wet soil, Vatva (18-9-55). On the walls of a masjid, Ahmedabad (20-9-55).

27. **Cylindrospermum catenatum** Ralfs.

Submerged under water in a drying puddle, near Chandola Lake Ahmedabad (20-11-55).

28. **C. licheniforme** Kuetz. ex Born. et Flah.

In a puddle, Sarkhej (10-10-55).

29. **C. muscicola** Kuetz. ex Born. et Flah.

On moist soil, Gujarat College Garden, Ahmedabad (23-8-55).

30. **Nodularia harveyana** Thuret v. **sphaerocarpa** (Born. et Flah.) Elenkin.

Floating in a small puddle, Bareja (15-4-55).

31. **Anabaenopsis circularis** (G. S. West) Wolosz. et Miller

In a tank near palace, Sarkhej (10-10-55).

32. **A. raciborskii** Wolosz.

Planktonic in a pond, Sanand (28-12-55).

33. **Nostoc carneum** Agardh ex Born. et Flah.

In puddles, Gujarat College Garden, Ahmedabad (23-8-55). On moist soil, Ahmedabad (28-8-55). In puddles, Ahmedabad (10-10-55).

34. **N. ellipsosporum** (Desm.) Rab. ex Born. et Flah.

On moist soil near a puddle, Sarkhej (9-10-55).

35. **N. minutum** Desm. ex Born. et Flah.

On moist soil, Ahmedabad (29-8-55).

36. **N. piscinale** Kuetz. ex Born. et Flah.

In a puddle, Ahmedabad (23-10-55).

37. **Wollea bharadwajae** R. N. Singh

Attached to submerged soil in a puddle, Barejadi (20-10-55).

38. **Anabaena ambigua** C. B. Rao

In a puddle, Sarkhej (9-10-55). Floating in a puddle near Chandola Lake, Ahmedabad (22-2-56).

39. **A. bolochonzewii** C. Meyer

Along with *Microcystis* sp. in a tank, Sarkhej (10-2-56).

40. **A. fertilissima** C. B. Rao

In a puddle, Sarkhej (9-10-55).

41. **A. laxa** A. Braun

In a puddle, Bareja (15-12-55). Submerged under water in puddles, Sanand (28-12-55).

42. **A. mediocris** Gardner

In a puddle, Sarkhej (9-10-55). Floating in a puddle, Barejadi (20-10-55).

43. **A. orientalis** Dixit

In a puddle, Sarkhej (9-10-55).

44. **A. volzii** Lemmermann

In a shaded puddle, Barejadi (20-10-55). Along with *Chara* sp. submerged under water in a puddle, Vatva (28-10-55).

ACKNOWLEDGEMENT

The author takes this opportunity to thank Dr. T. A. Rao, Ecologist, Botanical Survey of India, Calcutta, for encouragement.

BOTANY DEPARTMENT,
COLLEGE OF SCIENCE,
NAGPUR 1,
July 5, 1966.

N. D. KAMAT

Gleanings

Synchronous Flashing of Fireflies. Sir John and Elisabeth Buck, who have recently been observing synchronous flashing by fireflies in Thailand and Borneo (a phenomenon also reported from tropical India), make tentative suggestions regarding the build-up and purpose of their massive and long-lasting assemblies, which have been thus described by an earlier observer:

'. . . a tenth of a mile of river front with an unbroken line of *Sonneratia* trees with fireflies on every leaf and all the fireflies flashing in unison, the insects in the trees at the ends of the line acting in perfect unison with those between', the flashing occurring 'hour after hour, night after night, for weeks or even months . . .' The flashing is by the male insects.

Numerous insects have been found during the day on trees on which flashing was observed at night. The longevity of the individual insects is a few days at the most and reproduction seems to occur throughout the year. The flashing assemblies are generally confined to particular trees, although other trees apparently as suitable for the purpose occur in the near neighbourhood. Further, it has been observed with free flying fireflies in a dark room that there is a period, before the males alight and synchronous flashing begins to build up, when the insects are definitely attracted to each other. This suggests that the large assemblies are built up by positive phototaxis and, having once been established, are kept going by the resident population attracting other fireflies from the neighbourhood.

The females of the species studied are not apterous and have been found in large numbers on the trees observed and, as they do not take part in the flashing, are probably there for another purpose. In Jamaica large numbers of mating pairs were found in non-synchronous flashing trees under observation and the authors, who unfortunately did not investigate this particular point, found a mating pair on the gunwale of their canoe after beating the foliage in making a mass collection. It is therefore suggested that the flashing aggregations have a sexual significance. It is known that in most species of fireflies the sexes are brought together by photic signals between the individual insects. This is usually in open ground where the signals are easily observed. In the mangrove-nypa palm (*Nypa fruticans*) swamps of south-east Asia, where this mass flashing has been principally observed, the terrain does not lend itself to this sort of signalling. This, it is suggested, is the reason why the mass signalling method has evolved.

The authors, in conclusion, add that it would be optimistic to regard the problem raised as settled by observations over a few evenings; further investigation is called for.

Dr. John Buck & Elisabeth Buck: Biology of synchronous flashing of fireflies. *Nature*, Vol. **211**, No. 5049, pp. 562f, 6 August 1966.

Notes and News

Award of the Union Medal of the B. O. U. to Dr. Sálim Ali

Dr. Sálim Ali has been promoted to an Honorary Membership of the British Ornithologists' Union, a status accorded in the Rules of the Union to ' ornithologists resident outside the United Kingdom, elected on grounds of high distinction in the subject or in services contributing to its advancement, and shall not exceed fifteen in number at any time.' He has also been awarded—for the first time to a non-Britisher—the coveted Union Medal of the B.O.U. in recognition of his contributions to Indian ornithology over the past 40 years.

' Sterile-male ' Technique of Insect Control

Volume 57 of the *Journal* at page 175 carried a Gleaning regarding the use of the sterile-male technique for the eradication of the Screw-worm Fly in Florida. *Science News* of 11th March, 1967 (Volume 91, No. 10) reports that the fight continues and that a sterile-male barrier is maintained along the Texas border to exclude invasion from uncleared Mexico. The use of the technique is extending. It has been applied against the Melon Fly in Rota and Guam, and a Press Trust of India message in *The Times of India*, of 2nd May, 1967, reports its use against the Mediterranean Fruit Fly in the Island of Capri.

Mullet fry from captive fish

News from Israel of 1st July 1967 (published by the Consulate of Israel, Bombay) reports that scientists of the Dror Fish Culture Research Station and the Hebrew University of Jerusalem have, after several years of experiment, succeeded in obtaining mullet (*Mugil capito*) fry from captive fish treated with suitable hormones and kept in changes of water of successively increasing salinity. The process appears to be still in the laboratory stage. Further progress will be watched with interest.

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Journal of the Bombay Natural History Society

Vol. 64, No. 3

Editors
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ZAFAR FUTEHALLY, & J. C. DANIEL

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JOURNAL
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1967 DECEMBER Vol. 64 No. 3

Examples of Relationship between different forms of life in Tropical Africa

BY

A. BROSSET

(*With three plates*)

INTRODUCTION

Every form of life necessarily involves some relationship with other forms of life, and the problem[1] posed by the Bombay Natural History Society has to be clearly defined. It appears to me that the point of the inquiry is a review of cases where a species which is not really a parasite habituates itself to use the activities of another species for its own benefit, for its security, or for food, or for shelter.

Relationships of this sort are certainly much more numerous than we know of, especially in the tropics where animal communities are more intricate and have been less intensively studied. In comparison with other tropical countries, India has a tradition of interest and efficiency in the study of natural history. Hence, several cases of such relationships were first established in that country. Nevertheless, such relationships may be observed anywhere and I propose, in the present paper, to record briefly some observations on this subject recently made by me in tropical Africa.

---

[1] This article was written in response to a letter from the Honorary Secretary to members of the Society asking them to record their observations on animal associations.

ASSOCIATION OF THE BAT *KERIVOULA HARRISSONI* WITH THE SOCIAL SPIDER *AGELENA CONSOCIATA*

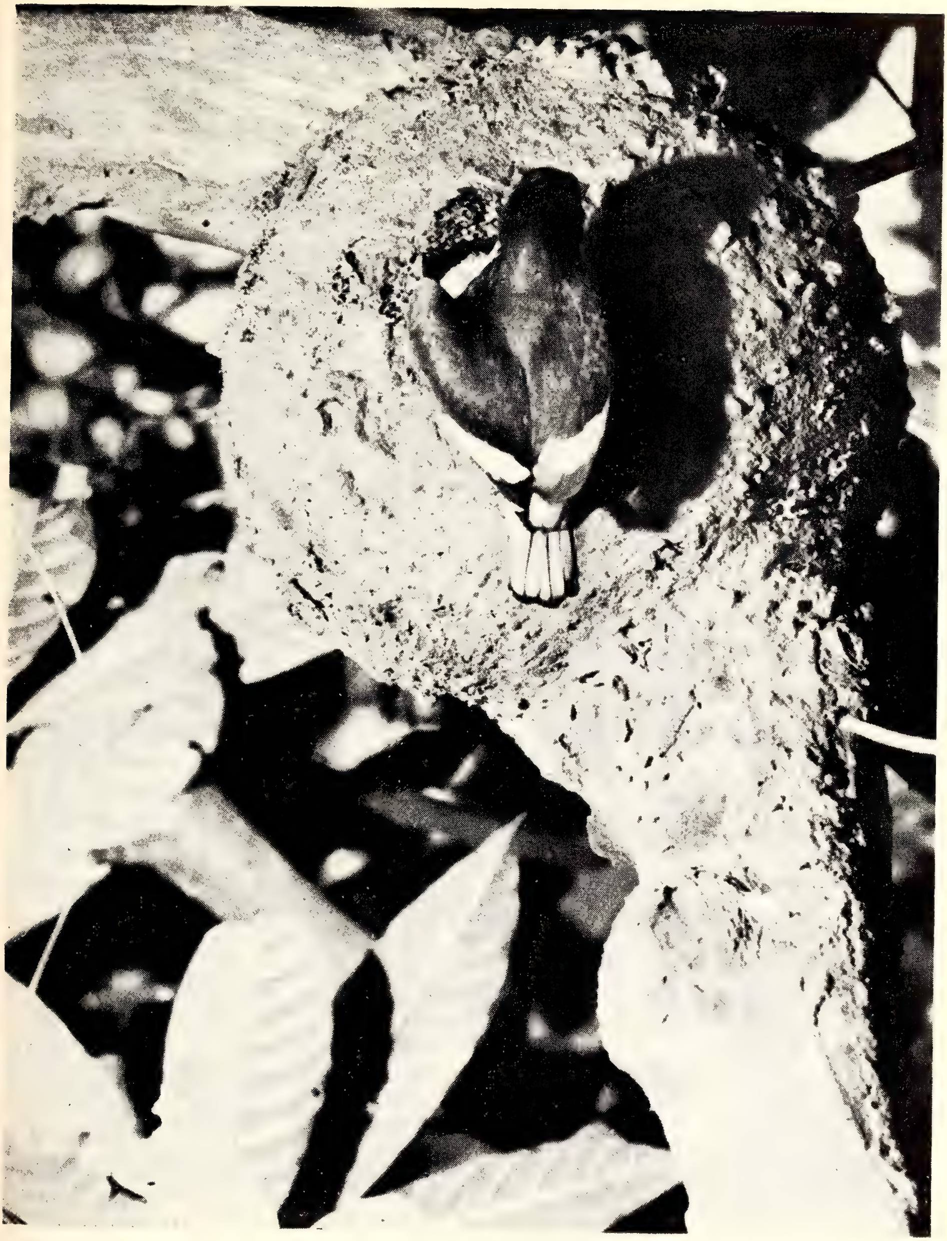
When I was staying at the French 'Mission biologique au Gabon' I was told by a fellow member, a specialist in spiders, that he had rather frequently observed some creature, either a small bat or a large moth, well inside the webs made by colonies of the social spider *Agelena consociata*—not being particularly interested he was not sure of the identity of the intruder. I verified the information and readily identified the intruder as the bat *Kerivoula harrissoni*, a small forest species. Later, I collected several specimens of the bat from other such webs and, further, I never saw the species in another type of diurnal roost.

Kerivoula harrissoni is neither solitary nor colonial in its habits. It seems to lead a family life, something that is rare among the numerous species of bats. Regularly we saw pairs in the webs, and sometimes a young one as well. The bats do not attach themselves to the webs, but they hang by their hind limbs from the twigs which support the webs. My friend Gerard Dubost, who was with me in Gabon, noticed that where the bats were hanging the bark of the twigs had been worn by their claws, a fact which suggests very sedentary habits on the part of the bats.

We observed no direct interference between the two species, the bats and the spiders, in their day to day life. It seems probable that the webs provide the bats with protection against predators and against the sun, particularly by reason of the dry leaves that the webs support. That dry leaves are an important factor of the diurnal biotope is suggested by the fact that the Indian Painted Bat of the same genus, *Kerivoula picta*, has been observed hanging during the day in bunches of dried leaves.

Generally speaking, bats of the genus *Kerivoula* are known to occupy rather unusual diurnal shelters. For instance, the African species *K. lanosa* and *K. nidicola* shelter in the nests of birds such as weavers and sunbirds. But this is the first record of a bat having its diurnal roost in a spider's web.

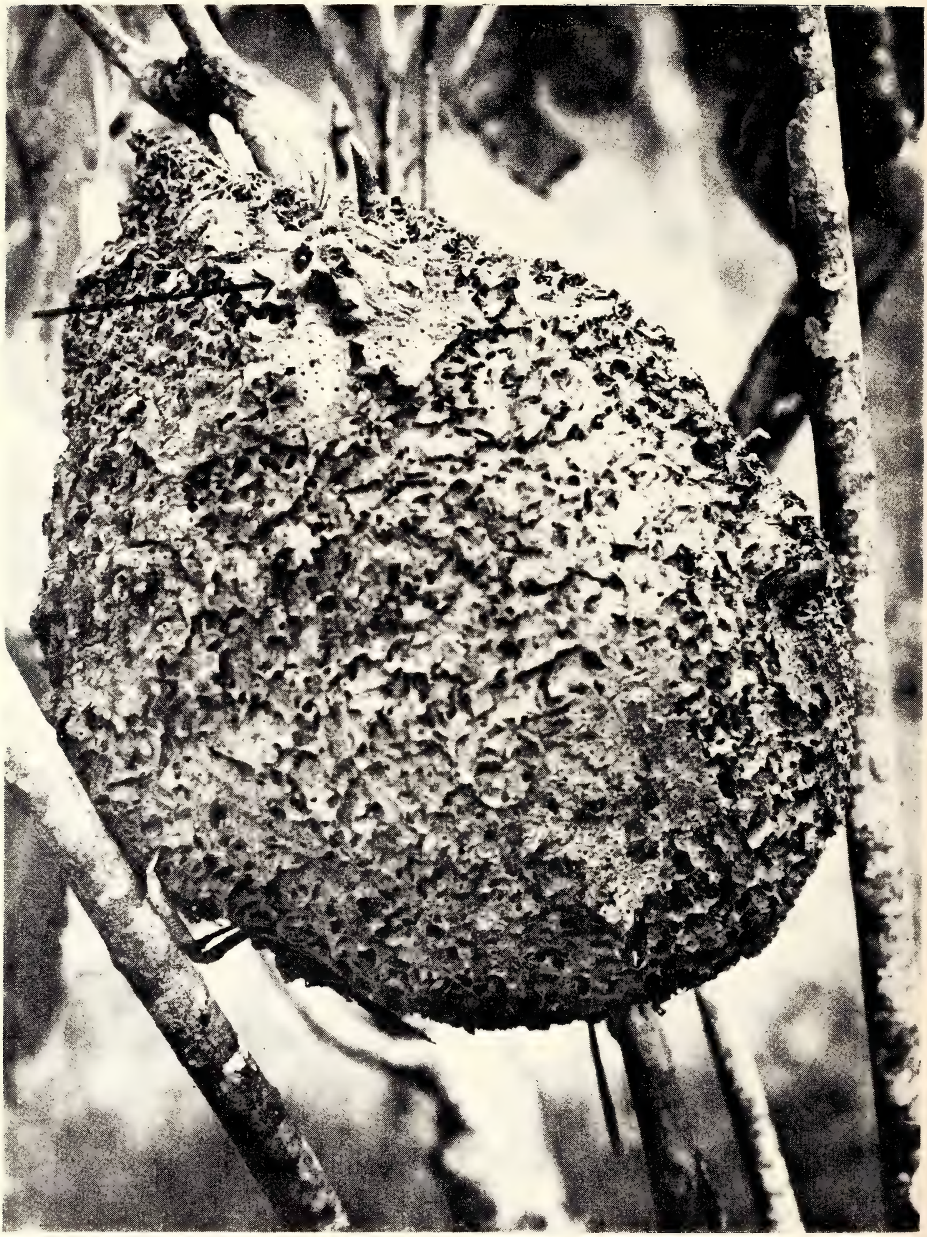
Brosset: Animal Associations



Kingfisher *Alcyon badia* feeding its young at nest in nest of arboreal termite *Nasutitermes.*

(*Courtesy*: *Mission biologique au Gabon—Director, Professor P. P. Grasse. Photo: A. R. Devez*)

Brosset : Animal Associations



Hive of bees *Trigona nebulata* made in woodpecker incubation chamber in nest of arboreal termite *Nasutitermes* (outside view).

Arrow shows entrance of bees, made by narrowing exit hole of the birds.

(Courtesy : Mission biologique au Gabon—Director, Professor P. P. Grasse. Photo : A. R. Devez)

A SUCCESSION OF PARASITIC INTRUDERS IN THE NEST OF THE ARBOREAL TERMITE *NASUTITERMES*

While studying termites, the head of the Mission, Professor P. P. Grassé, discovered in a nest of the arboreal termite *Nasutitermes* a clutch of eggs of birds which we identified as of a kingfisher (genus *Alcyon*). Several members of the Mission became interested as various vertebrates and invertebrates seemed to be associated with the *Nasutitermes* nests. The phenomenon was specially studied by Roger Darchen and me and we were able to establish a curious succession of parasitic intruders in the termite nests, which were very often occupied first by birds, then by honey bees, and finally by ants.

Occupation by birds

After the original discovery by Professor Grassé, we found several other birds' nests made inside the arboreal nests of the *Nasutitermes*. Three were made by the same species of kingfisher *Alcyon badia*, one by another kingfisher *Alcyon malimbica*, another by the woodpecker *Campethera permista*, two others by the woodpecker *Campethera nivosa*. We also found several empty nests in *Nasutitermes* nests, probably made by the same species of birds.

Birds of the woodpecker family are well-sinkers, whereas kingfishers are borers of tunnels. Each species of birds followed its family technique in the termite nests; the woodpecker worked from the top sinking a vertical excavation, while the kingfisher bored a round incubation chamber with the exit hole on the side.

Two eggs are the normal clutch of the birds nesting in the termite nests. In two cases of woodpeckers and in one of kingfishers only one young one was reared. In three cases, in spite of the apparently secure situation of the nest, the clutch was destroyed by predators.

The most exciting problem is still met within India and concerns the nest of the Rufous Woodpecker *Micropternus brachyurus* made in the nest of the ferocious *Crematogaster* ants: How can this small bird hatch its eggs and rear its young in the middle of a crowded colony of these aggressive insects, in a situation which a large mammal would not be able to endure for more than a few seconds?

For the Indian woodpecker it seems that the problem remains unsolved. For the Gabonese species careful consideration makes the solution clear. In the nests of the African woodpeckers *C. nivosa* and *C. permista* the cells of the termite nest remain open and communication between the birds and the termites is possible through the separating wall. Nevertheless, very few termites were seen in the incubation chamber—even none, if the termite nest was a small one. As woodpeckers are probably termite eaters, we may presume that the bird systematically eats any termites it sees when boring its nest and when hatching its eggs, so that very few of the termites remain when the young birds become fledglings.

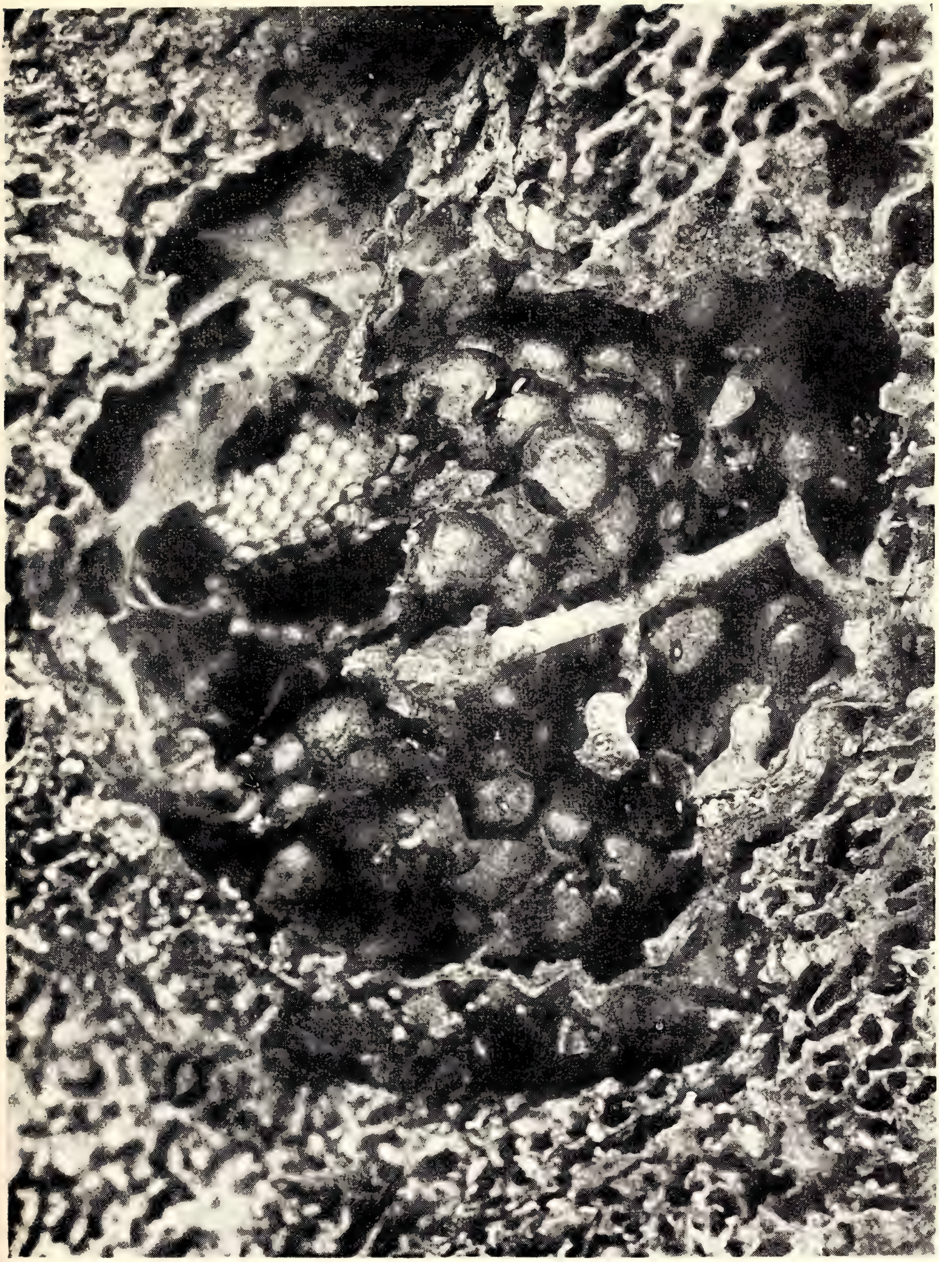
Rather different is the case of the kingfisher. These birds do not eat termites, and these insects being very numerous around the nest the bird probably does not destroy them. The five nests we saw with clutch and young were in the middle of crowded colonies of termites but were completely insulated from them by a wall of mud. This wall was made of the same raw materials as the body of the termite nest, and so we presume that this insulating wall was made by the termites themselves and not by the birds. But we may also presume that there is something special in the behaviour of the bird that induces the termites to make this dividing wall. In fact, holes and cracks made by man in the body of the nest are immediately repaired by the termites and the ball shape of the nest is restored. It would be interesting to know what it is that leads to the construction of this dividing wall.

Occupation by honey bees

The termites continue to lead their day to day life in their portion of the nest, while the birds hatch their eggs and rear their young in the portion taken possession of by them. The worries of the termites do not end when the birds leave for, more often than not, the honey bee *Trigona nebulata*, a very common species in that part of Africa, comes immediately to fill the incubation chamber with its hive. Roger Darchen, a specialist in bees and a fellow member of the French 'Mission biologique au Gabon', collected many such hives constructed in living colonies of *Nasutitermes* nests previously occupied by woodpeckers or kingfishers. A few such nests, situated in the garden of the Mission, were studied for a period of two years and the relationship of these animal communities is rather well known today.

At first the bees build inside the nest a thick insulating wall made by casting resin in the crevices of the incubation chamber of the birds. Then, with the same raw material, the exit is narrowed down till it forms a tube 20-30 mm. in diameter. This tube widens outwards at the surface of the nest to make the run-way for the landing of the bees. Inside the hive, we may observe stores of honey and pollen and the nest of the bees, surrounded by several sheaths.

Brosset : Animal Associations



Hive of bees *Trigona nebulata* made in woodpecker incubation chamber in nest of arboreal termite *Nasutitermes* (interior view, after opening the hive).

(Courtesy : Mission biologique au Gabon—Director, Professor P. P. Grasse. Photo : A. R. Devez)

Occupation by ants

In most of the cases observed by us the hives degenerated and, little by little, ants of the species *Cataulacus angolensis* took the place of the bees. It seems that these ants not only supplant the bees, but they also eat the honey and the pollen and, perhaps, the larvae of the bees.

Finally, the ants themselves may disappear, and the termites still living in the undisturbed part of their nest may recover the whole of their original home.

Readers interested in knowing more details on the subject are invited to refer to the journal *Biologia Gabonica* II—1966.

Notes on a Collection of Indian Birds, mostly from Delhi

BY

JULIAN P. DONAHUE
*Department of Entomology, Michigan State University,
East Lansing, Michigan, U.S.A.*

(*With three text-figures*)

Complete data are presented for 119 specimens of birds collected in 1961-1962 from Delhi, Punjab, Rajasthan, and Andhra Pradesh. Eighty-two species are represented, including eight new to the Delhi list : *Dupetor f. flavicollis*, *Amaurornis fuscus bakeri*, *A. akool akool*, *Caprimulgus i. indicus*, *C. macrurus albonotatus*, *Riparia riparia*, *Locustella lanceolata*, and *Chaetornis striatus*.

Despite the forbidding, semi-arid nature of its 574 square miles, the State of Delhi is a birdwatcher's paradise—especially in the winter, when so many Palaearctic species are present, and in the spring during the northward migration. Delhi has been fortunate in that many people assigned to work there, in governmental, military, or commercial capacities, have brought with them a keen interest in birds. And wherever birdwatchers go, a local list is soon to follow.

The first such list, based largely on specimens he collected, was published by Basil-Edwardes (1926). After a lapse of 21 years Frome (1947) published a second list, which generated a small flurry of corrections and additions (Alexander 1949 ; Benthall 1949 ; Frome 1948), culminating in yet another list (Alexander 1950). Sometime in the early 1950s a 12-page, indexed field check list was printed (anonymous, undated), listing 356 species then known to occur in Delhi. In 1953 (anonymous) a three-page list of corrections and additions to Alexander's 1950 list was published. In 1954 the Delhi Bird Watching Society published Hutson's THE BIRDS ABOUT DELHI, a fact-filled book containing data on 370 species. In 1962 I had the privilege of collaborating with Usha Ganguli and Harold Williams on a revised check list (anonymous, 1963), of 388 species, which updated the breeding and migratory status of many birds and incorporated the records contained in the present paper.

In addition to providing more detailed information on the eight species new to Delhi—Black Bittern (*Dupetor f. flavicollis*), Ruddy Crake (*Amaurornis fuscus bakeri*), Brown Crake (*Amaurornis a. akool*), Jungle Nightjar (*Caprimulgus i. indicus*), Longtailed Nightjar (*Caprimulgus* *macrurus albonotatus*), Collared Sand Martin (*Riparia riparia*), Streaked Grasshopper Warbler (*Locustella lanceolata*), and Bristled Grass Warbler (*Chaetornis striatus*)—indicated with a dagger (†) in the text, this paper presents brief data on my entire collection of Indian birds, consisting of 119 identified specimens representing 82 species. Most of the specimens are from Delhi, but small collections from Andhra Pradesh, Punjab, and Rajasthan are also included, and are marked with an asterisk (*). Unless otherwise noted, all specimens are deposited in the Museum, Michigan State University (MSU).

The major collecting sites were the Nursery, near the New Delhi residential area of Sundar Nagar, and in the vicinity of several large *jheels* (shallow lakes) south-west of Delhi. For a detailed discussion of the ecology, habitats, and climate of Delhi, with maps, see Donahue (1967).

Continued selective collecting in Delhi, concentrating on groups that are elusive or hard to identify in the field, such as warblers, nightjars, and rails, will add greatly to our knowledge of the Delhi avifauna. The cattail (*Typha*) marshes south of Okhla along the Agra Canal Road have been especially productive, and should be carefully observed for more records.

METHOD OF STUDY

The species are arranged, numbered, and named (with alternate names in parentheses) according to Ripley (1961). Subspecies were determined by comparison with specimens in the University of Michigan Museum of Zoology (UMMZ), where part of the huge Walter N. Koelz collection is housed, or at the American Museum of Natural History (AMNH), or by using published descriptions when the subspecific differences were obvious enough to prevent confusion. Credit is given when persons other than myself identified a particular specimen. In the several instances, where it was not possible to identify the subspecific population to which an individual belonged, this has been stated, and a multiple index number has been used.

The sex is given only when this has been ascertained by dissection, even in sexually dichromic species. The condition of the gonads, abbreviated as given below, serves as an indication of the sexual activity of the bird. Among the passerines the degree of ossification of the skull, given whenever this character was examined, indicates the age of the bird—an ossified skull signifying an adult bird.

All measurements, given only for the eight species new to Delhi, are in millimetres, and were taken according to the standards given by Baldwin *et al.* (1931).

The presence of external or internal parasites is noted where applicable. These nematodes and feather lice have been identified, and will be discussed in a later paper.

ABBREVIATIONS

Gonad Condition

♂♂	♀♀
t.n.e.=testes not enlarged	o.n.e.=ovary not enlarged
t.s.e. = ,, somewhat enlarged	o.s.e. = ,, somewhat enlarged
t.e. = ,, enlarged	o.e. = ,, enlarged
t.g.e. = ,, greatly enlarged	o.g.e.= ,, greatly enlarged

Ossification of the Skull

s.n.o. =skull not ossified
s.s.o. = ,, somewhat ossified
s.o. = ,, ossified

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Appreciation is also extended to Dwight C. Finfrock, formerly of New Delhi, for his aid in securing some of the specimens ; Irving J. Cantrall of the University of Michigan Museum of Zoology, who identified the locust eaten by a nightjar ; and to Usha Ganguli of Delhi, who served as a stimulating and knowledgeable companion during our many hours in pursuit of Delhi birds. My thanks also are due to George J. Wallace, who reviewed the manuscript.

ACCOUNT OF SPECIES

ARDEIDAE

57. **Ixobrychus sinensis** (Gmelin), Yellow Bittern.

1♂, 3½ miles S. of Okhla, Delhi, 2 June 1962. t.s.e. (left about twice size of right), MSU No. 4037.

Collected at 8 a.m., while it perched about 3 ft. off ground in cattails.

58. †**Dupetor flavicollis flavicollis** (Latham), Black Bittern.

1♀, 3½ miles S. of Okhla, Delhi, 11 May 1962. o.g.e., MSU No. 4038.

Collected at dusk by D. C. Finfrock, as it flew over dense bed of cattails, accompanied by a second bird. Stomach : 3 small fish. This species also seen in same locality on 1 June. Probably a resident species in the marsh. Tail with 11 feathers, instead of the usual 10. Measurements : wing 190, tail 72, culmen 83, tarsus 69, middle toe with claw 72. A widespread species, but new to the Delhi list. Field Marks : a very dark bird, with a large buff-and-white cheek patch and light streaks on the throat.

ACCIPITRIDAE

124. ***Elanus caeruleus vociferus** (Latham), Blackwinged Kite.

1♂, Pali, Rajasthan, 4 Oct. 1961. t.s.e., MSU No. 4039.

Solitary, perched on treetops in thorn scrub and cultivated land.

157. **Butastur teesa** (Franklin), White-eyed Buzzard.

1♀, 8 miles SW. of New Delhi, 19 Nov. 1961. o.n.e., MSU No. 4040 ; 1♂, 1 mile S. of Alwar, Rajasthan, 2 Oct. 1961. t.n.e., MSU No. 4041 ; 1♂, 26 miles NE. of Ajmer, Rajasthan, 2 Oct. 1961. t.n.e., MSU No. 4042.

MSU No. 4040. Sitting on haystack in centre of ploughed field, semi-arid land. Stomach : 1 or 2 mole crickets (Gryllotalpidae), and other insect matter. Mallophaga preserved. Adult.

MSU No. 4041. Perched on road sign in open country. Stomach : 1 large grasshopper, plus other insect remains. Adult.

MSU No. 4042. Feeding on ploughed ground near large shallow lake. Stomach : over 30 grasshoppers and a beetle. Juvenile.

169. **Aquila nipalensis nipalensis** (Hodgson), Steppe Eagle.

1♂, (?), 10 miles SW. of New Delhi, 27 Dec. 1961. MSU No. 4043.

On edge of large *jheel* with other eagles, feeding on dead duck. Stomach : mostly feathers. Five species of Mallophaga preserved.

191. ***Circus pygargus** (Linnaeus), Montagu's Harrier.

1♀, (?, in male plumage), 26 miles NE. of Ajmer, Rajasthan, 8 Oct. 1961. MSU No. 4044.

Feeding on open ploughed ground. Stomach : full of grasshoppers.

FALCONIDAE

222-224. **Falco tinnunculus** Linnaeus ssp., Kestrel.

1, ? sex, 10 miles SW. of New Delhi, 27 Dec. 1961. MSU No. 4045.

In open cultivated land, perching in trees and alighting on ground. Large amount of fat on body. Mallophaga preserved.

RALLIDAE

339. †**Amaurornis fuscus bakeri** (Hartert), Ruddy Crake.

1♂, 3½ miles S. of Okhla, Delhi, 1 June 1962. t.g.e., MSU No. 4046 ; 1♀ (juvenile), same locality, 1 July 1962. o.n.e., MSU No. 4047 ; 1♂ (juvenile), same locality, 1 July 1962, t.n.e., MSU No. 4048.

MSU No. 4046. On soggy ground near puddles in cattail marsh. Several others seen. Stomach : 18 vermiform insect larvae, 1 spider, several water-strider-like insects (Gerridae), 1 or 2 small snails, much unidentified insect matter, several pieces of gravel. Legs bright reddish pink. Subspecies confirmed at AMNH. The first record of this species from Delhi, and perhaps the southwestern-most record of this subspecies in India (see notes below).

MSU No. 4047. Same habitat. Stomach : small beetles, insect larvae, white gravel. Legs brown.

MSU No. 4048. Same habitat. Stomach : small beetles, insect larvae, much unidentified insect matter, small white gravel. Legs brown.

TABLE

MEASUREMENTS OF THE RUDDY CRAKES, IN MILLIMETRES

Specimen	wing	tail	culmen	tarsus	middle toe with claw
4046, adult♂	98	49	*c.* 19	37	44
4047, juv.♀	100	51	19	38	42
4048, juv.♂	100	52	19·5	36	42

[1] tip of bill broken off.

The Ruddy Crakes feed in the early morning (about sunrise) on the small open mud flats surrounded by cattails. They are very active feeders, and overturn and toss about bits of debris in their search for food. The birds jerk their tails constantly, in rhythm with their steps, They are not overly shy, and a fairly close approach is possible. A sudden movement or alarm sends the birds running, with wings fluttering, into the cattails. Only rarely did I see them fly.

The only call definitely attributable to this species was uttered by an adult bird on 7 June 1962, as it fed : a short *chuck* that is lower in pitch or softer, or both, at the end.

This subspecies ranges from the Afghan border in West Pakistan to Kashmir and in suitable areas to Assam, south to Bengal, East Pakistan, and Burma (Ripley 1961). *A. f. zeylonicus* Baker ranges from northwestern Mysore south to Ceylon (Ripley 1961). Humayun Abdulali (personal communication) informs me that there are two specimens from Bombay (outside the recorded range of either subspecies) in the Bombay Natural History Society collection. One was identified by Hugh Whistler as *A. fuscus fuscus*, while the second was marked as *A. fuscus bakeri* by Ripley who, however, omits mention of these birds in his SYNOPSIS (1961).

342. † **Amaurornis akool akool** (Sykes), Brown Crake.

1♂, 3½ miles S. of Okhla, Delhi, 2 June 1962. t.e., MSU No. 4049; 1♂, same data. t.s.e. (left over twice size of right), MSU No. 4050.

MSU No. 4049. Feeding in early morning on small, wet mud clearing in a cattail bed, with *A. fuscus bakeri*, *Porphyrio porphyrio*, and *Vanellus indicus*. Stomach : many small, black, unidentified insects, with small pieces of gravel. Measurements : wing 118, tail 57, culmen 32, tarsus 49, middle toe with claw 57.5. The first record of this species in Delhi, although it occurs south to central India.

MSU No. 4050. Stomach : one large (15 mm. long) hemipteran, a small snail, highly sclerotized arthropod pieces, and over 10 pieces of white gravel. Measurements : wing 122, tail 58, culmen 32, tarsus 50, middle toe with claw 57·5.

CHARADRIIDAE

Subfamily Scolopacinae

397. ***Tringa ochropus** Linnaeus, Green Sandpiper.

1♂, Pali, Rajasthan, 4 Oct. 1961. t.n.e., MSU No. 4051.

At a small puddle in thorn scrub and cultivated land.

BURHINIDAE

436. ***Burhinus oedicnemus indicus** (Salvadori), Stone Curlew.

1♀, 20 miles NW. of Hyderabad, Andhra Pradesh, 12 Aug. 1961. o.n.e., MSU No. 4052.

In teak (*Tectona grandis*) jungle. Nocturnal. Stomach : adult Coleoptera and a large millipede (Diplopoda).

GLAREOLIDAE

443. **Glareola pratincola maldivarum** J. R. Forster, Collared Pratincole.

1♀, 20 miles SW. of Delhi (Najafgarh Jheel), 16 June 1962. o.e., MSU No. 4084.

One of a large flock (over 300) resting on ground at edge of *jheel.* Hawked insects at sunrise like a nightjar, but gregarious and sedentary after 6 a.m. Call : a rising *chik*, and a tern-like *chrrrik*, both uttered in flight.

PTEROCLIDIDAE

492. ***Pterocles indicus indicus** (Gmelin), Painted Sandgrouse.

1♂, Badkhal Bund, Gurgaon District, Punjab (16 miles SSE. of New Delhi), 7 June 1962. t.s.e., in zoology teaching collection of G. J. Wallace, MSU ; 1♂, same data, t.n.e., MSU No. 4053.

This species was coming to water at dusk in groups of 2 or 3, or singly, in low rocky hills. Crop : full of a variety of dry seeds.

MSU No. 4053. Crop and Stomach : full of a variety of dry seeds, stomach with a few grains of quartz.

COLUMBIDAE

516-517. **Columba livia** Gmelin ssp., Blue Rock Pigeon.

1♀, New Delhi, 6 Sept. 1961. o.n.e., MSU No. 4054.

On old ruins in Nursery, in loose flocks that may be wild.

535. **Streptopelia tranquebarica tranquebarica** (Hermann), Red Turtle Dove.

1♀, 10 miles SW. of New Delhi, 22 March 1962. o.g.e., MSU No. 4055.

In tree in open cultivated land.

541. **Streptopelia senegalensis cambayensis** (Gmelin), Little Brown Dove.

1♂, New Delhi, 23 September 1961. t.g.e., MSU No. 4056.

Crop : full, almost entirely of two kinds of seeds.

PSITTACIDAE

549. **Psittacula krameri borealis** (Neumann), Roseringed Parakeet.

1♂, New Delhi, 28 June 1961. t.n.e., MSU No. 4057 ; 1♀, same data. o.n.e., MSU No. 4058.

One of the most common Delhi birds. Every evening large flocks of them fly into the city to roost, then fly into the surrounding countryside every morning to feed on crops. The abdomens of these specimens are lighter (more yellowish-green) than in most north Indian specimens examined.

CUCULIDAE

570. **Clamator jacobinus serratus** (Sparrman), Pied Crested Cuckoo.

1♀, New Delhi, 28 June 1961. o.g.e. (largest egg about 12 × 13 mm.), MSU No. 4059; 1♂, same data. t.s.e., MSU No. 4060.

In well-watered nursery and fruit grove.

MSU No. 4060. Large amount of fat on body. Stomach: over 50% of contents was large Hemiptera (' stink bugs ').

590. **Eudynamys scolopacea scolopacea** (Linnaeus), Koel.

1♀, New Delhi, 22 June 1961. o.e., MSU No. 4061; 1♀, same data. o.g.e., MSU No. 4062. One translucent egg about 16 mm. in diameter.

In well-watered shady grove.

596-598. **Taccocua leschenaultii** Lesson ssp., prob. *sirkee* (J. E. Gray), Sirkeer Cuckoo.

1♀, New Delhi, 26 June 1961. o.e., MSU No. 4063.

One of a pair in thorn scrub adjacent to fruit grove.

600-603. **Centropus sinensis** (Stephens) ssp., prob. *sinensis*, Crow-Pheasant.

1♀, New Delhi, 13 Nov. 1961. o.n.e., MSU No. 4064; 1, ? sex, 2½ miles S. of Okhla, Delhi, 23 July 1962.

MSU No. 4064. Collected along a brushy fence row. Okhla specimen collected on ground near canal, and donated to Bombay Natural History Society.

STRIGIDAE

627. ***Bubo bubo bengalensis** (Franklin), Great Horned Owl.

1♂, 15 miles NW. of Hyderabad, Andhra Pradesh, 4 Aug. 1961. t.e., MSU No. 4065.

At dusk, on top of boulder in rolling, rocky scrub area near a lake. Stomach: empty.

650. **Athene brama indica** (Franklin), Spotted Owlet.

1♀, New Delhi, 20 July 1961. o.n.e., MSU No. 4066.

On power line at dusk, in residential area. Stomach: unidentified insects, one spider with egg case.

CAPRIMULGIDAE

671. † **Caprimulgus indicus indicus** Latham, Indian Jungle Nightjar.

1♀, New Delhi, 27 July 1962. o.n.e., MSU No. 3821.

Collected at dusk as it flew through a dense locust swarm in the Nursery. Determined by Humayun Abdulali. Measurements: wing 181 (left), 182 (right); tail 136; culmen 14; tarsus 18; middle toe with claw 22. Stomach: one large locust (*Schistocerca gregaria* Forskal), det. I. J. Cantrall. This subspecies is lighter than the Himalayan *hazarae* Whistler & Kinnear. Although this species occurs throughout India, this is the first record from Delhi.

675. † **Caprimulgus macrurus albonotatus** Tickell, Longtailed Nightjar.

1♀, New Delhi, 31 Aug. 1961. o.n.e., MSU No. 4067.

Collected in late afternoon under dense canopy of *Citrus* in the Nursery. Identity confirmed by Humayun Abdulali. Stomach: a few hard insect parts, but no fresh material. Measurements: wing 197 (right), 196 (left); tail 150; culmen 11; tarsus 19; middle toe with claw 26. Both wings measured to tip of third primary; the second primaries, which are supposed to be the longest, are 52 mm. and 53 mm. shorter than the third primaries of the right and left wings, respectively. This subspecies is larger than *atripennis* Jerdon, and the bars on the underside are wider apart and more distinct. The first Delhi record for this widespread species.

680. ***Caprimulgus asiaticus asiaticus** Latham, Indian Nightjar.

1♂, Hyderabad, Andhra Pradesh, 8 Aug. 1961. t.s.e., MSU No. 4068; 1♀, same data. o.e., MSU No. 4069.

MSU No. 4068. In very rocky, rolling hills. Stomach: almost entirely beetles 8-9 mm. long, including one elaterid; also one piece of gravel 3 mm. in diameter. Wing 146 mm.

MSU No. 4069. Stomach: largely Coleoptera, including at least two elateridae, one large grasshopper, and possibly some crickets. An inordinately small specimen (wing 134 mm.).

682. **Caprimulgus affinis monticolus** Franklin, Franklin's Nightjar.

1♂, New Delhi, 23 July 1961. t.n.e., MSU No. 4070; 1♀, New Delhi, 17 Aug. 1962. o.n.e., MSU No. 3822.

MSU No. 4070. Collected at dusk, sitting on ground in semi-arid land. Identity confirmed by Humayun Abdulali. Stomach: nearly empty, but portions of elaterid and lucanid beetles were identified.

MSU No. 3822. Collected in evening from dense tangle of thorn bushes, emitting a *chuck-chuck* call as it rose. Tail and, to slight extent, wings in moult. Juvenile.

APODIDAE

707. ***Cypsiurus parvus batasiensis** (J. E. Gray), Palm Swift.

1♂, 12 miles N. of Hyderabad, Andhra Pradesh, 3 Aug. 1961. t.s.e., MSU No. 4073; 1♀, same data. o.s.e., MSU No. 4074.

MSU No. 4073. One of a loose flock over cultivated land. Mallophaga preserved.

MSU No. 4074. In flock, with some swallows, over cultivated land.

ALCEDINIDAE

735-738. **Halcyon smyrnensis** (Linnaeus) ssp., Whitebreasted Kingfisher.

1♀, New Delhi, 19 June 1961. o.n.e., MSU No. 4078; 1♂, New Delhi, 16 July 1961. t.n.e., MSU No. 4079.

MEROPIDAE

747. **Merops superciliosus persicus** Pallas, Bluecheeked (Large Green), Bee-eater.

1♂, 10 miles SW. of New Delhi, 27 May 1962. t.e., MSU No. 4076; 1♀, 20 miles SW. of New Delhi, 25 July 1962. o.n.e., MSU No. 4077.

MSU No. 4076. One of a group of 10 or so making sallies after flying insects from a tree near a large *jheel.*

MSU No. 4077. One of several juveniles, capable of flight, being fed by adults on tree near large lake. Stomach : insect matter, including Odonata (dragonflies). Considerable amount of fat on skin of lower back. Call (Fig. 1) : a trilled, musical repeated in rapid sequence, differing from call of adults.

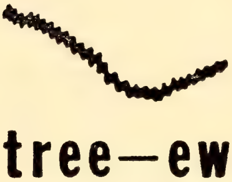

Fig. 1

750. **Merops orientalis orientalis** Latham, Common Green Bee-eater.

1♀, New Delhi, 13 Nov. 1961. o.n.e., MSU No. 4075.

CORACIIDAE

755-757. **Coracias benghalensis** (Linnaeus) ssp., prob. *benghalensis* Indian Roller.

1♂, New Delhi, 18 May 1961. t.s.e., MSU No. 4080.

UPUPIDAE

763-766. **Upupa epops** Linnaeus ssp., Hoopoe.

1♂, New Delhi, 26 July 1961. t.n.e., MSU No. 4081; 1♂, New Delhi, 23 Sept. 1961. t.e., MSU No. 4082.

MSU No. 4081. On ground in Nursery. Stomach: Hemiptera, Coleoptera, and other arthropod remains.

MSU No. 4082. A partial albino specimen, described and illustrated in Donahue (1963). Collected at dusk from tree.

CAPITONIDAE

780. **Megalaima zeylanica caniceps** (Franklin), Green Barbet.

1, ? sex, New Delhi, 22 June 1961. MSU No. 4083.

In fruit grove in Nursery.

PICIDAE

796. **Jynx torquila torquila** Linnaeus, Wryneck (or possibly ssp. *chinensis* Hesse).

1♀, New Delhi, 24 Dec. 1961. o.n.e., MSU No. 4086.

Solitary and shy, in the Nursery. Stomach: black insects, possibly ants. Det. C. Vaurie, 1963.

818-819. **Dinopium benghalense benghalense** (Linnaeus) $\lesssim$ *dilutum* (Blyth), Lesser Goldenbacked Woodpecker.

1♀, New Delhi, 15 Nov. 1961. o.n.e., MSU No. 4085.

An intergrade; the darker back and ear coverts make it appear closer to *benghalense* (compared with specimens in AMNH). Stomach: almost entirely ants (Formicidae).

ALAUDIDAE

875-877. **Mirafra erythroptera** Blyth ssp., Redwinged Bush Lark.

1♂, 10 miles SW. of New Delhi, 25 March 1962. s.o., t.e., MSU No. 4090.

On roadside near cultivation, occasionally flying to utility wire to sing.

878. **Eremopterix grisea** (Scopoli), Ashycrowned (Blackbellied) Finch-Lark.

1♀, 10 miles SW. of New Delhi, 27 Dec. 1961. s.o., o.n.e., MSU No. 4088.

Part of a small flock feeding on ground in open, dry cultivated land.

*1♂, Hyderabad, Andhra Pradesh, 3 Aug. 1961. t.e., (right almost spherical, left normal), MSU No. 4089.

In very rocky area. Stomach : vegetable matter, mostly seeds.

898-900. **Galerida cristata** (Linnaeus) ssp., Crested Lark.

1♂, New Delhi, 22 May 1961, s.o., t.e., MSU No. 4091 ; 1♂, same data, s.o., t.e., MSU No. 4092 ; 1♀, New Delhi, 5 Nov. 1961, s.o., o.n.e., MSU No. 4093.

MSU Nos. 4091 & 4092. On roadside. Det. by C. Vaurie.

MSU No. 4093. On ploughed ground surrounded by sugar-cane fields. Stomach : small seeds. Det. by C. Vaurie.

904-909. **Alauda gulgula** Franklin ssp., Eastern (Little) Skylark.

1♂, New Delhi, 5 Nov. 1961. s.o., t.e., MSU No. 4087.

On ploughed ground surrounded by sugar-cane. Stomach : small seeds.

HIRUNDINIDAE

910-911. †**Riparia riparia** (Linnaeus) ssp., prob. *diluta* (Sharpe & Wyatt) Collared Sand Martin.

1♂, 10 miles SW. of New Delhi, 22 March 1962. t.n.e., MSU No. 4072.

One of one or two individuals of this species with a flock of Common Swallows (*Hirundo rustica*) on power lines near a wheat field. Measurements : wing 93, tail 43, culmen 5·5, tarsus 9·5, middle toe with claw 13. I first saw this species in Delhi on 28 Dec. 1961. H. G. Alexander (unpublished notes) first saw it on 10 Feb. 1960, and again on 27 March. It may breed in Delhi, but is more probably a winter visitor. This is the first definite record of this species in Delhi, and possibly the south-western-most record in India.

912. **Riparia paludicola chinensis** (J. E. Gray), Plain (Indian) Sand Martin.

1♀, New Delhi, 27 March 1962. s.n.o., o.n.e., MSU No. 4071.

Sitting on utility wire with others of same species, in Nursery, over open waste land with bank where they probably nest.

916-918. **Hirundo rustica** Linnaeus ssp., (Common) Swallow.

1♂, 10 miles SW. of New Delhi, 19 Nov. 1961. s.o., t.n.e., MSU No. 4094 ; 1♀, 15 miles SW. of New Delhi, 17 July 1962. s.s.o., o.n.e., MSU No. 4095 ; 1♂, 15 miles SW. of New Delhi, 25 July 1962. s.o., t.n.e., MSU No. 4096.

MSU No. 4094. Gregarious, perched on utility line near water. Stomach : small insects, including Coleoptera. Many endoparasitic nematodes preserved.

MSU No. 4095. On utility wire in open country, associated with Cliff Swallows (*H. fluvicola*). Stomach : Coleoptera and other small insects. Under wing coverts in light moult. Three nematodes preserved.

MSU No. 4096. Sitting on utility wire over water, in mixed flock with *H. fluvicola*.

Although this species does not breed in Delhi, it is almost never entirely absent. The lowest population occurs in June.

LANIIDAE

933. **Lanius excubitor lahtora** (Sykes), Grey Shrike.

1♀, 10 miles SW. of Delhi, 27 Dec. 1961. s.o., o.n.e., MSU No. 4119.

In open cultivated land, flying to ground from perch on small thorn trees. Mallophaga preserved.

DICRURIDAE

962-964. **Dicrurus adsimilis** (Bechstein) ssp., Black Drongo.

1♂, New Delhi, 5 Nov. 1961. s.s.o., t.n.e., MSU No. 4097.

One of several catching insects disturbed in grain field by Bank Mynas (*Acridotheres ginginianus*). Stomach : large grasshoppers and other insects. According to Ripley (1961), ssp. *albirictus* (Hodgson) has been recorded from Delhi.

STURNIDAE

994. **Sturnus pagodarum** (Gmelin), Blackheaded (Brahminy) Myna.

1, ? sex, New Delhi, 15 July 1961. s.s.o., MSU No. 4120.

Stomach : 8 vermiform insect larvae (probably Diptera), and small seeds.

1006. **Acridotheres tristis tristis** (Linnaeus), Common Myna.

1♀, New Delhi, 21 June 1961. o.e., MSU No. 4148.

1008. **Acridotheres ginginianus** (Latham), Bank Myna.

1♀, New Delhi, 18 May 1961. s.o., o.e., in zoology teaching collection of G. J. Wallace ; 1♂, same data. s.o., t.e., MSU No. 4121 ; 1♂, same data. s.o., t.e. (left larger than right), MSU No. 4122 ; 1♂, same data. s.o., t.e. (left larger than right), MSU No. 4123.

Part of a large colony nesting in bank near roadside.

CORVIDAE

1031-1034. **Dendrocitta vagabunda** (Latham) ssp., Indian Tree Pie.

1, ? sex, New Delhi, 2 Sept. 1961. s.o., MSU No. 4099; 1♂, New Delhi, 18 July 1962. s.s.o., t.n.e., MSU No. 4100.

MSU No. 4099. In tree in residential area.

MSU No. 4100. In Nursery. Stomach : 2 *neem* seeds (*Azadirachta indica*), and a scarabaeid beetle. Under wing coverts and thighs in light moult.

1059. ***Corvus corax subcorax** Severtzov, Raven.

1♀, 26 miles NE. of Ajmer, Rajasthan, 2 Oct. 1961. s.o., o.n.e., MSU No. 4098.

One of a pair feeding on cattle dung in open scrub-land.

CAMPEPHAGIDAE

1069. **Tephrodornis pondicerianus pallidus** Ticehurst, Common Wood Shrike.

1♂, New Delhi, 25 Sept. 1961. s.s.o., t.n.e., MSU No. 4117.

IRENIDAE

1100. ***Aegithina tiphia deignani** Hall, Common Iora.

1♂, Hyderabad, Andhra Pradesh, 8 Aug. 1961. s.o., t.e., MSU No. 4116.

Singing in garden.

PYCNONOTIDAE

1126-1132. **Pycnonotus cafer** (Linnaeus) ssp., Redvented Bulbul.

1, ? sex, New Delhi, 21 June 1961. s.o., MSU No. 4105.

In young mango and lime grove. Probably ssp. *humayuni* Deignan, recorded from Delhi in Ripley (1961).

MUSCICAPIDAE

Subfamily Timaliinae

1254. **Turdoides caudatus caudatus** (Dumont), Common Babbler.

1♀, New Delhi, 22 June 1961. s.s.o., o.n.e., MSU No. 4101.

1255-1256. **Turdoides earlei earlei** (Blyth) $\lesssim$ *sonivia* (Koelz), Striated Babbler.

1♀, 10 miles S. of New Delhi, 7 May 1962. s.o., o.s.e., MSU No. 4102 ; 1♀, 3½ miles S. of Okhla, Delhi, 1 July 1962. s.o., o.g.e., MSU No. 4103.

MSU No. 4102. One of a party of 3 or more, in small trees at edge of cattail marsh. The Delhi population appears to be an intergrade between the western *sonivia* and the eastern *earlei*: Delhi specimens appear almost identical to a specimen of *sonivia* from Lahore, West Pakistan, in the AMNH, but are generally lighter in coloration than specimens of *earlei* from Uttar Pradesh eastwards (*e.g.*, the breast and underside are lighter, and the streaks on the head and back are narrower).

MSU No. 4103. One mallophaga preserved.

The call of this species is a rather slow

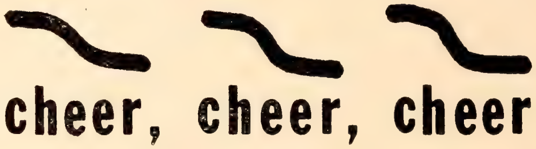

Fig. 2

1261-1266. **Turdoides striatus** (Dumont) ssp., Jungle Babbler.

1♀, New Delhi, 16 July 1961. s.s.o., o.n.e., MSU No. 4104.

One of a small party in Nursery. Stomach : unidentified insect remains. Probably ssp. *sindianus* (Ticehurst), recorded from Delhi in Ripley (1961).

Subfamily Sylviinae

1498. **Cisticola juncidis cursitans** (Franklin), Streaked Fantail Warbler.

1♀, 10 miles S. of New Delhi, 5 May 1962. s.n.o., o.n.e., MSU No. 4125.

On edge of and in bed of cattails near cultivation. Flies like a *Prinia.*

1503. **Prinia hodgsonii hodgsonii** Blyth, Franklin's Longtail (Wren-) Warbler.

1, ? sex, New Delhi, 9 May 1962. MSU No. 4126.

Singly or in pairs in thorn forest on Ridge. Moulting on head, primaries, and tail.

1506. **Prinia buchanani** Blyth, Rufousfronted Longtail (Wren-) Warbler.

1♂, Tughlakabad Fort, 10 miles S. of New Delhi, 5 March 1962. s.o., t.e., MSU No. 4130.

In wheat field, flying to scattered low thorn-scrub when disturbed. White tips of tail feathers visible only when bird is landing.

1508. **Prinia gracilis lepida** Blyth, Streaked Longtail (Wren-) Warbler.

1♂, New Delhi, 15 Nov. 1961, s.s.o., t.n.e., MSU No. 4129.

One of a small, loose group in brush and on ground in and near wild cane (damp area). Determined with R. L. Fleming, Jr., compared with Koelz specimens at UMMZ.

1510. **Prinia subflava terricolor** (Hume), Plain Longtail (Wren-) Warbler.

1♂ (?), New Delhi, 29 Aug. 1961. s.n.o., MSU No. 4131; 1♀, New Delhi, 19 Nov. 1961. s.o., o.n.e., MSU No. 4136.

MSU No. 4131. In pairs, in semi-arid thorn scrub. Common.

MSU No. 4136. In wild cane, in damp situation.

1515. **Prinia socialis stewarti** Blyth, Ashy Longtail (Wren-) Warbler.

1, ? sex, New Delhi, 6 Sept. 1961. s.s.o., MSU No. 4127; 1♂, New Delhi, 5 Nov. 1961. s.s.o., t.n.e., MSU No. 4128.

MSU No. 4127. In thorn scrub bordering Nursery. Tail feathers being replaced.

MSU No. 4128. In tall grass and scrub. Stomach : small insects.

1517. ***Prinia socialis socialis** Sykes, Ashy Longtail (Wren-) Warbler.

1♂, Hyderabad, Andhra Pradesh, 17 Aug. 1961. s.o., t.e., in zoology teaching collection of G. J. Wallace.

Singing, in rocky scrub. Makes clicking sound as it flies. 10 tail feathers.

1544. † **Locustella lanceolata** (Temminck), Streaked Grasshopper Warbler.

1♂, New Delhi, 17 Aug. 1962. s.s.o., t.n.e., MSU No. 3823.

Measurements : wing 56, tail 47, culmen 10·5, gape 14, tarsus 19·5, middle toe with claw 16·9. Silent, in thick bushes adjacent to unseasonally dry damp area of tall wild grass, in Nursery. Field marks : heavily streaked above, necklace on upper breast, short rounded tail, very faint supercilium. A new record for Delhi, and the southwestern-most record in India. Identity confirmed by Sálim Ali. There is a specimen in the Bombay Natural History Society collection from Kutch, Gujarat, which has not been reported in the literature and represents an even farther range extension.

1547. † **Chaetornis striatus** (Jerdon), Bristled Grass Warbler.

1♂, 2 miles S. of Okhla, Delhi, 23 July 1962. s.o., t.e. (right testis spherical, about ⅔ size of normal left testis), MSU No. 4124.

Singing at 6 a.m., solitary, in tall marsh grass beside Agra Canal Road (milepost 2). Soft parts : mouth black ; iris light brown ; upper mandible greenish-black, lower bluish-grey, darker at base and on edges ; legs flesh-pink, toes light brown, pads flesh-white, claws dark brown. Measurements : wing 92, tail 90, culmen 12·5, gape 18, tarsus 30, middle toe with claw 29·5. Field marks : like *Acrocephalus stentoreus* but much darker, with a streaked back, short heavy bill, and no conspicuous supercilium. A rather widespread species endemic to the Indian subregion, but apparently local and rare. New to the Delhi list.

This specimen has a 'necklace' formed by the dark shafts of the breast feathers, a character not previously mentioned in published descriptions. This character is variable : although all specimens I have examined have stiffened breast feathers, only a few of the birds have the darkened shafts. The AMNH has only 3 specimens of this bird, one of which has the necklace, while a second bird has a few darkened shafts. Humayun Abdulali informs me that the necklace is visible in only one of the three specimens in the Bombay Natural History Society collection (all males), although the stiff shafts may be felt in all three specimens.

The call (Fig. 3), which I believe has never been described, is a pleasant, musical uttered from an exposed position on tall marsh grass or a bush.

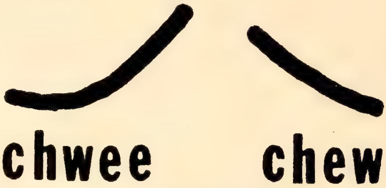

Fig. 3

1556. **Acrocephalus dumetorum** Blyth, Blyth's Reed Warbler.

1♂, 5 miles S. of New Delhi, 4 May 1962. s.o., t.n.e., MSU No. 4134.

Apparently many, migrating. Active in thorn trees, catching insects. Determined with aid of R. L. Fleming Jr., compared with Koelz collection at UMMZ, and confirmed by Charles Vaurie.

1562. **Hippolais caligata caligata** (Lichtenstein), Booted Warbler.

1♂, 15 miles SW. of New Delhi, 6 Aug. 1962. s.s.o., t.n.e., MSU No. 4132.

One of two birds in clumps of grass and small, isolated scrub brush in dry cultivated land. Determined with aid of R. L. Fleming Jr., compared with specimens at UMMZ, and confirmed by Charles Vaurie.

1567-1568. ***Sylvia curruca** (Linnaeus) ssp., Lesser Whitethroat.

1, ? sex, Pali, Rajasthan, 4 Oct. 1961. s.s.o., MSU No. 4133.

In thorn scrub cropland. Identity confirmed by C. Vaurie.

1574-1576. **Phylloscopus collybita** (Vieillot) ssp., Brown Leaf Warbler (Chiffchaff).

1♀, New Delhi, 13 Nov. 1961. MSU No. 4137.

Active in low bushes in Nursery.

Subfamily Turdinae

1644-1646. **Erithacus svecicus** (Linnaeus) ssp., Bluethroat.

1♂, New Delhi, 5 Nov. 1961, s.s.o., t.n.e., MSU No. 4113.

In tall grass and border of ploughed field, feeding on ground. Stomach : ants and other insects.

1692. **Cercomela fusca** (Blyth), Brown Rock Chat.

1♀, Tughlakabad Fort, 10 miles S. of New Delhi, 5 March 1962. s.o., o.n.e., MSU No. 4110.

Common about ruins of fort, on rocks and on ground. Stomach: insects, including parts of at least one grasshopper.

1700. **Saxicola caprata bicolor** (Sykes), Pied Bush Chat.

1, ? sex, New Delhi, 22 May 1961. s.n.o., MSU No. 4114; 1♂, same data. s.o., t.e., MSU No. 4115.

1710. **Oenanthe deserti deserti** (Temminck), Desert Wheatear.

1♂, 10 miles SW. of New Delhi, 19 Nov. 1961. s.s.o., t.n.e., MSU No. 4111. 1♀ same data. s.s.o., o.n.e., MSU No. 4112.

Together on freshly-ploughed ground. Stomach: both had small insects. This subspecies is smaller than *oreophila* (Oberholser), and has less white in the wing.

1♂ (?), same locality, 27 Dec. 1961. s.s.o., in zoology teaching collection of G. J. Wallace, MSU.

On cultivated ground, perching on low bushes.

1717-1721. **Saxicoloides fulicata** (Linnaeus) ssp., Indian Robin.

1♂, New Delhi, 28 June 1961. s.n.o., t.n.e. MSU No. 4108; 1, ? sex (in male plumage), New Delhi, 13 Nov. 1961. s.s.o., MSU No. 4109.

MSU No. 4108. In rocky, open scrub land. Probably subspecies *cambaiensis* (Latham), reported from Delhi by Ripley (1961).

1726. **Monticola solitarius pandoo** (Sykes), Blue Rock Thrush.

1♂, New Delhi, 12 Nov. 1961. s.s.o., t.n.e., MSU No. 4107.

Feeding on ground, perching on brick ruins in Nursery. Photographed in life, in colour. Stomach: small seeds and insect matter. This subspecies is darker than *longirostris* (Blyth).

1763. **Turdus ruficollis atrogularis** Jarocki, Redthroated Thrush.

1♂, New Delhi, 27 March 1962. s.o., t.n.e., MSU No. 4106.

In waterlogged area with canopy of thorny legume trees, in Nursery, where this species was present throughout the previous winter.

MOTACILLIDAE

1875. **Motacilla flava thunbergi** Billberg, Yellow (Greyheaded) Wagtail.

1♂, 10 miles SW. of New Delhi, 19 Nov. 1961. s.o., t.n.e., MSU No. 4118.

On edge of roadside mud puddle.

NECTARINIIDAE

1907. ***Nectarinia zeylonica sola** (Vieillot), Purplerumped Sunbird.

1, ? sex, Hyderabad, Andhra Pradesh, 10 Aug. 1961. s.o., MSU No. 4140; 1♂, same locality, 17 Aug. 1961. s.o., t.e., MSU No. 4141.

Both in a garden.

1917. **Nectarinia asiatica asiatica** (Latham), Purple Sunbird.

1, ? sex, New Delhi, 28 June 1961. MSU No. 4138.

In Nursery.

*1♂, Hyderabad, Andhra Pradesh, 17 Aug. 1961. s.o., t.n.e., MSU No. 4139.

In garden.

ZOSTEROPIDAE

1933. **Zosterops palpebrosa palpebrosa** (Temminck), White-eye.

1♀, New Delhi, 15 Nov. 1961. s.o., o.n.e., MSU No. 4142; 1♂, same data. s.o., t.n.e., MSU No. 4143.

Both from a flock in large tree in the Nursery.

PLOCEIDAE

1938. **Passer domesticus indicus** Jardine & Selby, House Sparrow.

1♂, New Delhi, 6 Sept. 1961. s.o., t.g.e., MSU No. 4144.

1966. ***Lonchura malabarica malabarica** (Linnaeus), Whitethroated Munia.

1♀, Hyderabad, Andhra Pradesh, 17 Aug. 1961. s.o., o.g.e., MSU No. 4145; 1♂, same data. s.o., t.e. (left about twice as large as right), MSU No. 4146.

Both in a garden.

1974. ***Lonchura punctulata punctulata** (Linnaeus), Spotted Munia.

1♀ (?), Hyderabad, Andhra Pradesh, 10 Aug. 1961. s.o., MSU No. 4147.

Nest of grass, globular, about 5 ft. off ground in dense cedar bush.

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A New Annonacea from the Andaman Islands

BY

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Central National Herbarium, Botanical Survey of India, Howrah

(*With a plate*)

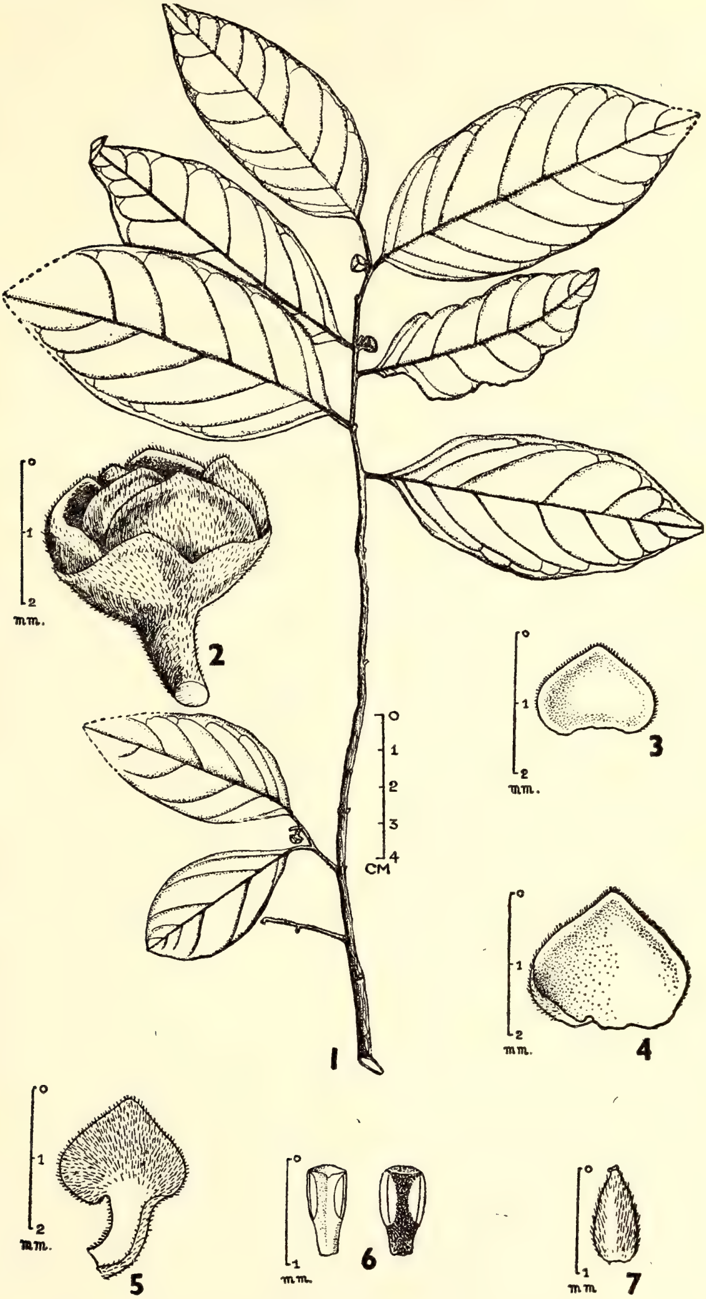
Mitrephora andamanica Thoth. et. Das, sp. nov.—tribe Mitrephoreae, sub-family Annonoideae, family Annonaceae is described from the Andaman Islands.

Mitrephora andamanica sp. nov.

Accedit proxime ad *M. lanotan* (Blanco) Merr. a qua tamen differt habitu, foliorum pagina inferiore puberula, sepalis et petalis minoribus, petalis interioribus utrinque pubescentibus, et numero ovulorum.

Frutex 1-1·5 m. altus, ramulis nigris, sulcatis, puberulis. *Folia* alterna, exstipulata, ovato-elliptica vel oblonga, 8·5-13×3·5-5·5 cm., coriacea, supra glabra, infra puberula praesertim ad nervos, integra, acuta ad apicem, angusta ad basin, nervorum lateralium 6-7 paribus ascendentium; petiolo 3-6 mm. longo, supra canaliculato, puberulo. *Inflorescentia* cymosa, extra-axillaris, oppositifolia, 1-2-flora. *Flores* hermaphroditi, 3-3·5×4-5 mm., cremei; pedicelli 1-2 mm. longi, pubescentes; bractea ovata, acuta, extus pubescens, bracteola ad medium pedicelli, extus pubescens. *Sepala* 3, triangularia, libera, 1·5×1·5-2 mm., extus pubescentia. *Petala* 3+3, in alabastro valvata; exteriora late ovata, 3-4×3-4 mm., acuta ad basin concava, extus pubescentia, ciliata; interiora distincte unguiculata, exterioribus paulo breviora, 3×2-3 mm., (lamina cordata), supra cucullata in pileum mitriformem, pubescentia in utraque facie. *Stamina* plura, uvarioidea, 0·75-1 mm. longa, antherarum cellulis amplis, connectivo dorsali complanato ad apicem. *Torus* planus, pilis albis insignitus. *Carpella* 3 apocarpia oblonga et angulosa, 0·75-1 mm. longa, stylodiis nullis; stigma sessile, discoideum; ovulis 2-3. *Fructus* ignotus.

Thothathri: *Mitrephora andamanica* sp. nov.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Mitrephora andamanica Thoth. et Das, sp. nov.

1. Branch with flowers; 2. Flower; 3. Sepal; 4. Outer Petal; 5. Inner Petal; 6. Stamens (Back and front views); 7. Carpel.

Typus lectus in insula Baratang, in Andaman meridionali die 30 aprilis 1964 a K. Thothathri; holotypus et isotypi (*Thothathri* 10840 A et 10840 B-F respective) positi in CAL.

Mitrephora andamanica Thoth. et Das, sp. nov. is closely allied to *M. lanotan* (Blanco) Merr. but differs from the latter in habit, lower surface of the leaves being puberulous, sepals and petals being smaller, inner petals being pubescent on both sides and in the number of ovules.

A *shrub*, 1-1·5 m. high; branchlets black, furrowed, puberulous. *Leaves* alternate, exstipulate, ovate-elliptic to oblong, 8·5-13 × 3·5-5·5 cm., coriaceous, glabrous above, puberulous especially on midrib and nerves below, entire, acute at apex, narrow at base, lateral nerves 6-7 pairs, ascending; petiole short, 3-6 mm. long, grooved above, puberulous. *Inflorescence* extra-axillary, leaf-opposed, 1-2-flowered cyme. *Flowers* hermaphrodite, 3-3·5 × 4-5 mm., creamy yellow; pedicels short, 1-2 mm. long, pubescent; bract ovate, acute, pubescent externally, bracteole at the middle of the pedicel, pubescent externally. *Sepals* 3, triangular, free, 1·5 × 1·5-2 mm., pubescent externally. *Petals* 6 in 2 whorls of 3 each, valvate in bud; outer broadly ovate, 3-4 × 3-4 mm., acute, concave at base, pubescent externally, ciliate; inner distinctly clawed, slightly shorter than outer, 3 × 2-3 mm., blade cordate, vaulted above into a mitriform cap, pubescent on both sides. *Stamens* numerous uvarioid, 0·75-1 mm. long, anther cells large, dorsal connectives flat at top. *Torus* flat, studded with white hairs. *Carpels* 3, apocarpous, oblong and angled, 0·75-1 mm. long, stylodia absent; stigma sessile, discoid; ovules 2-3. *Fruit* not known.

The type collected from Baratang Island, South Andaman on 30th April 1964 by *K. Thothathri* (Holotype *Thothathri* 10840 A; Isotypes *Thothathri* 10840 B-F) have been deposited in the Central National Herbarium, Calcutta (CAL).

ACKNOWLEDGEMENTS

Our grateful thanks are due to Dr. H. Santapau, Director, Botanical Survey of India, Calcutta, for the latin diagnosis and to Dr. S. K. Mukherjee, Keeper, Central National Herbarium, for encouragement.

On the Development of *Artemia salina* L. (Crustacea: Anostraca)[1]

BY

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(*With a plate*)

INTRODUCTION

Previous work on the development of Anostracans, apart from early observations reported by Claus (1885) comprise Cannon's (1924) brief account of the development of the fairy shrimp, *Chirocephalus diaphanus* and Heath's (1924) extensive account of the development of Anostracans. Weisz (1946), who was primarily interested in segment formation in relation to size and shape, described growth rate in *A. salina.* Hall (1959a, 1959b) published brief accounts of the development of the eggs of *Chirocephalus* in relation to depth of water and low temperature. Pai (1958) described the post-embryonic stages of the phyllopod crustaceans, *Triops* (*Apus*), *Streptocephalus*, and *Estheria.* Recently Prophet (1963) studied the influence of temperature, drying, dilution of the culture medium, egg age, etc. on the hatching of Anostracan eggs. This paper is an account of the development of *Artemia salina.*

METHODS

Artemia eggs were collected from Sambhar Salt Lake, Rajasthan. The eggs were kept in the laboratory in lake water of different salinities to study the relation between hatching time and salinity. Yeast pellets were given as food to the developing nauplii. The larvae were fixed in Bouin's fluid at intervals and stained with borax carmine. The observations recorded in this paper are from whole mounts as well as from living specimens from the aquaria.

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[1] This work was carried out in the Department of Zoology, University of Rajasthan, Jaipur (India).

OBSERVATIONS

The eggs are spherical, hard-shelled, brown-coloured, often floating on the surface in long interlocking filaments. Each egg measures 0·25-0·30 mm. in diameter (Plate, 1). Drying was not necessary for hatching; eggs kept at 60° C. for 48 hours hatched quickly.

Stage 1: hatching to 18 hours; (Plate, 2-4).

The larva at this stage is a nauplius. Initially, it is 0·2 mm. long with broad head, three pairs of cephalic appendages (antennules, antennae, and mandibles), and an unsegmented trunk. The head is distinguished from the trunk region by a constriction visible from the ventral side, and also by the nuchal organ on the dorsal side. As in other branchiopods, the antennules are uniramous and unsegmented, and bear only two terminal setae. The antennae comprise a sympod of two segments and an unsegmented simple exopod and endopod. The first segment bears at its distal end a stout bifid curved spine which is frequently referred to as a masticatory process. The bifid point of this spine lies just behind the mouth, between the long labrum and the ventral side of the body. The second segment bears a single posterior seta at its distal end. The seta is long and its distal half has no setule as reported by Heath (1924). The exopod bears two long terminal setae and a row of seven long ventral setae with no setules but with a distinct hinge at about their midpoint. The endopod, sharply separated from the exopod, is quite short, only one-third of the length of the exopod, and bears four long terminal setae of the same form and about as long as the ventral setae of the exopod. The mandibles are uniramous and about as long as the sympod of the antenna. Its segmentation is not clearly marked but it appears to comprise a large basal plate (sympod) and a short terminal joint (endopod). There are six setae in all, a terminal group of three rather short smooth setae and three stout setulose spines on the inner side of the sympod. As the two mandibles work more or less in a plane parallel to the ventral surface of the body, the inner spines of each approximately oppose those of the other. The labrum is very large lying against the ventral surface. It overlaps the mandibles completely. The median eye (ocellus) is a tiny pigmented spot in between the two compound eyes, which are not pigmented. The dorsal or nuchal organ, highly swollen up with yolky material, is found below the eyes.

In the later changes the trunk grows more slender. The rudiments of the maxilla, maxillulae, and the first four swimming appendages are visible through the delicate cuticle. The larvae at this stage are 0·4 mm. long and have commenced to feed.

Stage 2: 18+ to 42 hours; (Plate, 5).

The larva at this stage measures 0·49-0·69 mm. (average of 34 specimens 0·61 mm.). The three pairs of cephalic appendages are as in stage 1 but the cilia are long and tapering. The posterior end of the trunk shows a rudiment of the caudal cerci. The maxillae and maxillulae have essentially the same form that they have in later stages. Each maxilla consists of a basal portion, the protopodite, to which a slender appendage is attached latero-posteriorly. Each maxillula is little more than a low conical elevation rising immediately behind the maxilla and is usually inclined towards the mid-line. The free end of the maxillary palp carries two delicate setae. The median eye becomes more pigmented and is very conspicuous at this stage. Each compound eye becomes enlarged and migrates away from the median eye. The dorsal organ occupies a larger portion of the cephalic region and does not show any change in shape. Ventrally the labrum covers the mouth. All the appendages seem to rise from the mid-ventral line of the body. The trunk region shows as many as five segments.

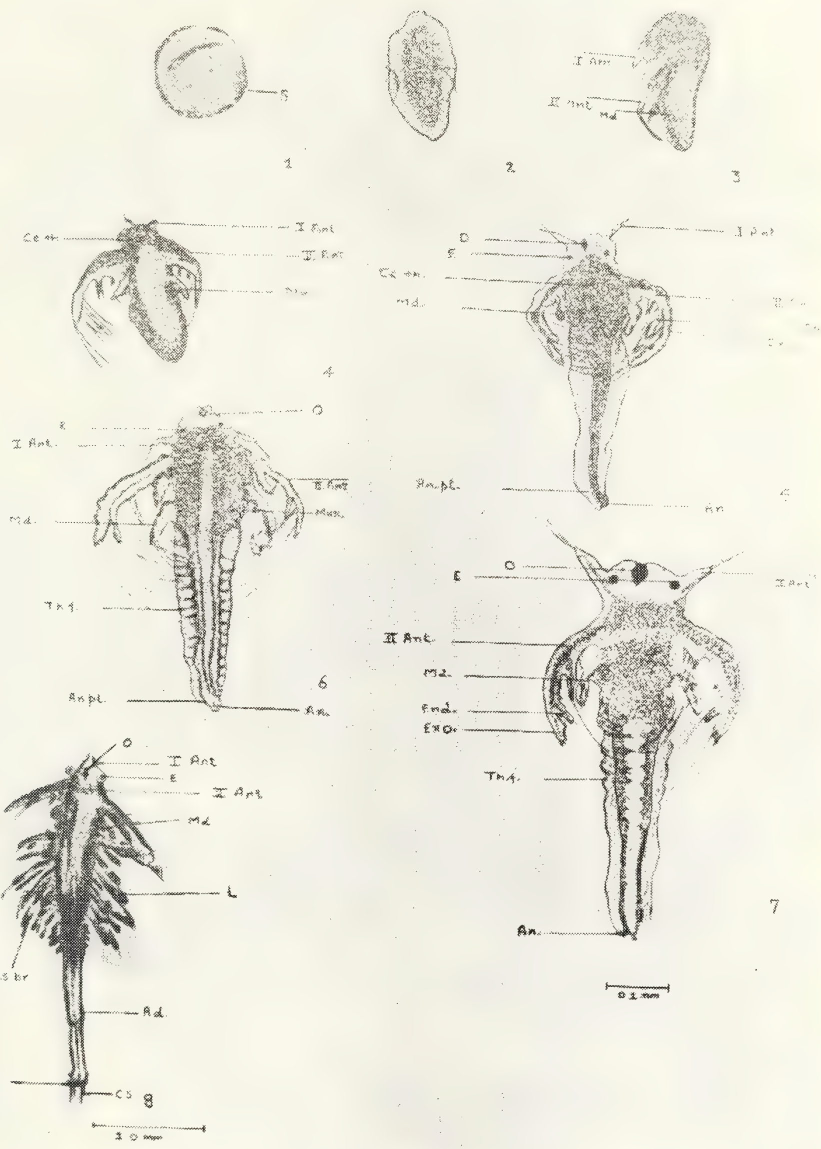
The later changes involve an increase in the length of the maxillary region, and of the antennae and mandibles. The compound eyes are as prominent as the median eye.

Stage 3: 42+ to 66 hours; (Plate, 6).

The larva is now 1·2 mm. long. The antennule is short, straight, unsegmented, with two bristles. The antennae and mandibles have increased in length. The endopodite of the antenna is thumb-like and is supplied with long setae. The maxillary region is much larger since the maxillary gland develops in the larval stages. In the trunk region nine buds of appendages having flagella protrude, the first six showing more or less clearly defined endites. Posterior to this the buds become less conspicuous and finally there is an unsegmented part. The alimentary canal is seen with two digestive pouches below the transparent exoskeleton and the food is visible in the form of suspended particles.

Stage 4: 66+ to 96 hours; (Plate, 7).

The larva is *c* 2·6 mm. long. The compound eyes are elevated above the cephalic region and are borne on stalks. The antennae and mandibles become more ventral in position. The mandibles are now in the form of a pouch. The maxillary glands are well developed below the mandibles. Eleven pairs of thoracic appendages are seen, the first four with endites and the other seven in the form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Stages in the development of *Artemia salina* L.

Fig. 1. Egg; Figs. 2-8. Larva at different stages (in hours from hatching); Figs. 2-4. hatching to 18 hrs.; Fig. 5. 18+ to 42 hrs.; Fig. 6. 42 to 66 hrs.; Fig. 7. 66+ to 96 hrs.; Fig. 8. 96+ to 144 hrs.

Ad. Abdomen; An. Anus; An.pl. Anal plate; I Ant. Antennule; II Ant. Antenna; Ce.th. Cephalothorax; C.S. Caudal setae; E. Eye; End. Endopodite; Exo. Exopodite; L. Leg; Md. Mandible; Max. Maxilla; O. Median eye; Res.br. Respiratory bract; S. Shell; Th.f. Thoracic fold.

of protuberances. The bracts of the first four limbs are clearly formed. The flabella are also distinctly formed and show clear demarcation from the last endite at one end to the bract at the other. The thoracic and abdominal regions are more clearly marked than in the previous stages. The abdominal region has no appendage.

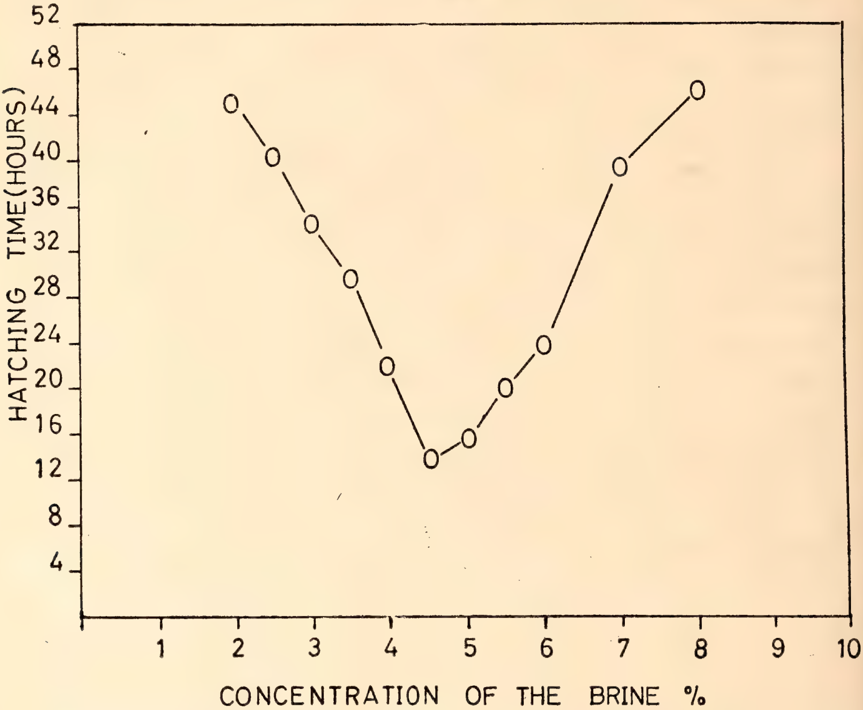
Stage 5: 96+ to 144 hours; (Plate, 8).

The larva is 4·5 mm. long. The appendages of the thoracic region are very well developed and are followed by seven abdominal segments without appendages. The first nine appendages of the thorax have well marked endites, flabella, and bracts. The first limb appears distinctly smaller than the second limb. The antenna at this stage is completely rotated on the ventral side and is very much reduced, thereby indicating the female sex. In the female, a thickening in the form of a rounded elevation is developed around the posterior region of 11th thoracic segment and first and second abdominal segments which form the egg pouch. The caudal furcae are elongated and have nine setae. The frontal organs have become plumose and sensory. The larva is almost an adult now. In the later stages the larva grows in size.

DISCUSSION

The newly hatched larva is a true nauplius without any segmentation in the trunk region but possesses a median eye in the anterior part of the head and three pairs of cephalic appendages. The larvae show phototropic movements and are found at the surface feeding on the scum deposited on the sides of the aquarium. Their number is more on sides which are towards light. This observation is true when the depth of water in the container is more than 6 cm. otherwise they are equally distributed. The time taken for hatching in different salinities is shown in the text-figure below. It shows that 4·5% salinity with a hatching time of 12 hours is the most suitable concentration. The hatching time for mud containing eggs is about 24-48 hours after immersion. Most workers (Heath 1924, Pai 1958) have obtained nauplius larvae in 24-48 hours. The larvae also hatch out more quickly in summer than in winter. In winter hatching is delayed by 12 hours.

The larva of *Artemia* is easily differentiated from other branchiopod nauplii immediately at hatching. It has no carapace, no segmentation in the post-mandibular region, lacks two anal setae but has three pairs of cephalic appendages, and has a prominent sessile median eye in the notch in the anterior part of the head.



Text-figure. Relationship between hatching time of *Artemia salina* eggs and the salinity of the medium.

Segmentation and appendages

External appearance of segmentation is noticeable 22 hours after hatching when, along with trunk segments, 4-5 buds of appendages of the trunk are seen to protrude. The first thoracic appendage with its endites is seen in the larvae of 40-48 hours after hatching, and the distal endite of this appendage develops into a respiratory bract. Lankester (1881) stated that the epipodites are richly supplied with blood and he called them 'branchiae'. In the present study on *Artemia*, it is found that the number of segments has no relation with the number of appendages and further the number of segments is more than the number of appendages of the adult. Linder (1952) elucidated the relationship between the number of segments, the number of appendages, and the number of posterior apodous segments, while working on the North American Notostraca. According to him there is no correlation between the number of appendages and the segments bearing them.

The three cephalic appendages, viz. antennules, antennae, and mandibles, show interesting variation in the phyllopods. In *Artemia*, the antennules are uniramous and unsegmented, and have two bristles at the free end. The antennae and mandibles are strong and biramous, and carry long setae. Setules as found in the larvae of other Anostracans (Heath 1924, Pai 1958) are absent. Later, these appendages undergo reduction. The antennae are small in the female. This observation could not be made in the male, since the eggs are parthenogenetic. The mandible loses its biramous character and develops into a cup-shaped structure with spines. The first trunk appendage by this time is fully developed and is provided with endites. It functions as a swimming appendage.

Development of appendage

Each swimming appendage appears in the form of a low ridge (Plate, 6) when viewed posteriorly and totally lacks the characteristic divisions of the fully developed organ. This is the typical condition of the seventh body segment in stage 3. The appendages anterior to it show four sub-divisions. Along the dorsal border in contact with the body proper are branchial lobes (Linder 1952, called them praeepipodite and epipodite). The branchial section is separated by a distinct notch from the slightly differentiated flabellum (Linder 1952, called it exopodite) whose limit more ventrally is indicated by a cleft adjacent to the region of the future endites. The endites comprising somewhat the larger portion of the appendage bear one small notch which marks the outer limit of the gnathobase. The two branchial lobes are clearly defined and are sharply separated by a comparatively deep cleft from the flabellum. Each of the six endites is formed on the inner side of the appendage. The early appearance of the flabellum, its position with reference to the principal axis of the appendage, and the fact that it bears one to two small setae corresponding to those on 6 endites, suggest that the flabellum is an exopodial structure and the endites endopodial as Huxley and others suggested long ago.

Eye and Maxillary gland

The median pigmented nauplius eye is visible in the early larval stage (stage 1) in a notch in the anterior part of the head. It persists up to 48 hours. In stage 2 both the median eyes and paired sessile eyes are seen but, faintly, in larvae of 96 hours the paired eyes are borne on stalks. The maxillary gland is found below the second maxilla and appears in a 30-hour old larva. It becomes conspicuous in 66 hours.

Rate of growth

Martin & Wilbur (1921), Heath (1924), Bond (1933), and Warren (1938) reported that the adult size of *Artemia* varies inversely with the salinity of the medium and animals bred in the laboratory attain sexual maturity three to four weeks after hatching. According to Jenson (1918) *Artemia* from the Great Salt Lake mature sexually 18 to 21 days after hatching in brine of unspecific salinity. Barigozzi (1939) measured the average time of development from hatching to sexual maturity in three populations of brine shrimp at 18-20° C. in artificial sea-water. According to Weisz (1946) the rate of development of *Artemia* from hatching to sexual maturity is directly related to the salinity of the external medium. Animals reared in dilute brine (salinity 3·0%) are sexually mature in about 32 days after hatching while those in more concentrated brine (salinity 11·5%) are sexually mature in about 22 days. Gilchrist (1960) reported that the rate of growth varies with size, sex, and stock of animals. According to Baid (1963) *Artemia* reared in 12·5% salinity have a higher rate of growth than those reared in 6·5% salinity. In early stages the size or growth-rate is directly related to the salinity of the medium but the size of the adult brine shrimp varies inversely with the salinity of the medium (Baid 1963).

SUMMARY

Eggs are brown, spherical, and hard shelled, and hatch in 12 hours in 4·5% salinity. The various stages in development of *A. salina* are described, from newly hatched nauplius to near adult. Three pairs of cephalic appendages show maximum growth in length within 30-48 hours after hatching; after 72 hours progressive reduction occurs till antennae become almost vestigial and mandible changes into a cup-shaped structure with spine on it; the antennule, however, persists. Segmentation of trunk region increases progressively, leaving a posterior unsegmented region. Buds of appendages on trunk segments increase in regular antero-posterior order. The two branchial lobes are clearly defined and are sharply separated by a comparatively deep cleft from the flabellum or exopodite. Median sessile eye degenerates and the two compound eyes on either side become stalked.

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A Note on Nagaland

BY

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Nagaland has an area of some six thousand square miles with a population of about four lakhs. It is almost entirely a hilly area with only small patches of flat land, in the plains bordering Assam. The country has an axis approximating to north-east south-west, but the hills themselves have a general north-south grain, with drainage both into the Assam valley and the Chindwin valley of Burma, and to some extent into the Manipur basin. The elevation of the hills increases towards the east and the highest range is found on the border of Burma, Mt. Saramati, almost twelve thousand feet high. In the centre of Naga Hills there is a concentration of high peaks in the Barail Range, overlooking the main Dimapur-Kohima-Imphal road and drained by the Barak River. The Barak flows south into Manipur, whence, after a sharp 180 degrees turn into the Cachar District of Assam, where it is known as the Surma, it flows into East Pakistan to join the Brahmaputra river system. The northern face of the Barail Range gives rise to a number of small and shorter streams which flow into the main Assam valley of the Brahmaputra.

Climatologically the Naga Hills are a monsoon belt with one pronounced 'rain shadow' area to the north, at the point where these hills join the main Cachar-Khasi-Mikir hills massif. In this rain shadow area, which embraces the foothills and plains around Dimapur (or Manipur Road of wartime fame) and through which the railway line to Upper Assam runs, the rainfall is as low as 60 in., whereas on the Burma border and on the slopes of the Barail Range the rainfall is much heavier and goes up to 120 in.

From the vegetational aspect the Naga Hills are more interesting than the Khasi Hills, because of the change in forest types which takes place as one proceeds up the valley of the Brahmaputra. The forests on the neck of the hill range dividing the Brahmaputra and Surma valleys, consist first of a 'dry' evergreen belt containing the locally noted *Bonsum* (a species of *Phoebe*), and further eastward a 'moist' type characterised by the giant Dipterocarp *Hollong*, sister to the *Gurjan* of the Andamans so well known to the timber trade of

Calcutta. This *Hollong* forests extends along the foothills of the Naga country up to the tip of the valley, near the point where the Burma-China-India triangle begins. The main associate of *Hollong*, *Makai* (*Shorea assamica*), extends to elevations around 3000 ft. On the other side of the dividing mountains, in Burma, teak commences. Teak is not found within Nagaland proper, although it occurs in adjoining Manipur on the slopes going down into the Chindwin drainage. The strip of country between 2000 ft. and 5000 ft. generally is the main habitated and cultivated portion of Nagaland. In the interior of the Naga Hills at elevations above 3000 ft., the Dipterocarps give way to a peculiar type of evergreen forest which deserves the name 'temperate' evergreens, as they are found on the higher and cooler elevations. This forest type consists of a number of interesting species belonging to families such as Micheliaceae, Magnoliaceae, and Lauraceae and also a species of *Phoebe*. In addition, the genera *Elaeocarpus*, *Castanopsis* and *Quercus* are represented, the first named at higher elevations, the second in the moister localities and valleys, and the last favouring the more open and drier slopes adjoining cultivation. Cane is generally absent at the higher sites, as also the characteristic palm, *Pinanga gracilis*, of the lower evergreens.

Generally speaking the forests of Nagaland may be classified as 'relict' forests, since they are survivors of what was originally a great forested area which has been subjected to *jhuming* or shifting cultivation for hundreds of years. This feature is not exclusive to these hills, but is common to all the hill ranges on the southern bank of the Brahmaputra which have been the home of tribal races whose way of life is connected with *jhuming* from time immemorial. The remnants of the forests are to be found mainly on the tops of the hills and in the bottom of the deep, ravine-like valleys of the streams which drain from them. Everywhere else the vegetation has been changed by the axe and fire. Only where it is not possible to grow rice or millets because of increasing elevation, has the forest been left alone. These forested caps of the mountains are clearly visible when flying over Nagaland and constitute a unique feature of an otherwise rather monotonous expanse of secondary jungle. But the scene is not as monotonous as the one presented by the Lushai, or Mizo Hills as they are now known, where the secondary vegetation consists entirely of bamboo. The Reserved Forests of Nagaland comprise 127 square miles and the Protected Forests some 200 square miles only.

The *jhum* cycle in these eastern hills has been gradually tightening, until it is down to three to five years in the worst places while it is about eight to ten years in the best. The average length of the *jhum* cycle in the Naga Hills is ten years. This shortening of the *jhum* cycle has been brought about by a combination of factors, of which the most important are the decreasing soil fertility, as the result of progressive loss of top soil with each felling and burning and the consequent decline in crop productivity on the one hand, and the steadily increasing population, as the result of improved health and sanitation resulting in decreased mortality and greater longevity, on the other. To those who have not seen a *jhum* plot in its various stages in the hills of north-eastern India it is impossible to visualise the drastic erosion of soil which takes place each time the land is cut over, burned and exposed. The coincidence of the *jhuming* season—February to April—with the onset of the early showers of rain which characterise the pre-monsoon period in the Assam region, results in the soil being freshly exposed to the erosive action of the rain before the crop that is sown or other vegetation can cover it. The result is rivulets of reddish or brownish soil flowing down the steep slopes and taking away at one stroke the valuable top soil, which in this case has had only a few years to build up. The only compensation is the ash produced from the burning of the trees and vegetation, which is the sole reason for any crop being possible at all. No fertiliser is applied, nor is any attempt made to hold up the soil except in rough and ready attempts at bunding by laying the unburnt trees and branches across the slope. This, however, is a feature in certain parts of Nagaland only. Elsewhere the tribal has been content to wrest what he can from his land while watching helplessly the removal of its most valuable component, the top soil.

In the period intervening between two successive cultivations, grasses first come up, and in some areas an impoverished form of bamboo. Where the period is long enough, as is the case in NEFA and Nagaland, trees begin to invade and take over the grass-covered land. Such species as have seed dispersal by wind colonise the place *en masse*. But before the process has had time to result in even a partial restoration of the tree growth, the *jhum* cultivator comes round with his *dao* and cuts and burns the vegetation for his next crop! And so the process of destruction goes on, until all that can survive on the meagre soil and after repeated cuttings and burnings is an undergrowth of fire-hardy species of reeds and grasses, such as *Imperata* (thatch) and *Saccharum* species in the lower elevations, *Neuradia* (ekra) and *Thysanoleurum* (broom) in the higher elevations and straggling weeds, a common plant being *Eupatorium odoratum*, with a few trees resulting from coppice shoots and pollarded stems, and here and there a young tree of seedling origin.

In this 'desert' of vegetation, figuratively speaking, hardly any animal life can be found. A few ground animals such as lizards, porcupines and mongooses, minor predators and where the vegetation is more favourable deer and pig, with an occasional tiger or leopard. Elephants, though greatly reduced, are found in the valleys of the foothills. Birds are to be found, some rare and interesting, in the forested areas although over large stretches of the country the song of birds is not to be heard. The Naga is an avid eater of meat and kills and eats anything he can find. He has practically exterminated the fauna in certain valleys, and although he does not indulge in the ritual hunts of the central Indian tribal people, he is continuously on the look-out for an opportunity to secure meat. Strangely enough he has no use for the tiger, of which he wants neither the meat nor the skin. A couple of years ago a family of five tigers which were unlucky enough to stray to the vicinity of Mokokchung, were eliminated in a well organised hunt but their carcasses were stretched out on bamboo frames and allowed to rot at the entrance of the village of Ungma, the parent village of the Ao Nagas.

The primitive form of land-use in India known as shifting cultivation, which extends into Burma and the mountain country farther east on the one side, and into the central Indian plateau on the other, has been carried on over a long period of time with very little being done to remedy this state of affairs. All authorities who have come in touch with the problem agree that it represents a future that is dark and full of despair for the people of the hills. 'Eliminate *jhuming*' has been the cry, but no answer is given to the practical question of how to replace it. 'Terrace cultivation' is little more than a slogan to a people who have not got the time and the energy to convert the mountain slopes to terraces for permanent cultivation. *Jhuming* is one of the most arduous forms of cultivation imaginable and the *jhum* cultivator has to work for nearly 365 days in the year and 12 hours a day to eke out a bare pittance from his land. The never ending cycle of cultivating a current *jhum* and with it preparing for the next year's *jhum* is interspersed only by labour on building and repairing houses, fetching firewood for the family etc. An occasional hunting trip or festival, when drinking and sports take over, brighten the otherwise monotonous life of the *jhum* cultivator. Where is the time and the energy for the laborious carving out of terraces from the hill-sides? Even if the government were to subsidise such form of cultivation the expenditure would be prohibitive, while the manpower requirements would be such as could not be met. The use of bulldozers to cut terraces out of the hill-side has only limited application, and only where the slope is not excessive. In many cases perennial irrigation is not available and the terraces have to depend on rain water. The growing of cash crops, which has been recommended as a 'cure all' has also certain limitations. In the Mizo Hills vast quantities of oranges are produced but have no value because there is no market. The theory of exchange between the plains and the hills, the farmer sending his surplus rice up and the latter sending down his cash crops, is no doubt one of the answers to the problem, but it would necessitate a complete change of outlook on the part of the conservative hillman and involve a network of roads which would be beyond the reach of even a modern welfare State.

Improved methods of *jhuming* are part of the programme of the agricultural authorities in these eastern hills, but so far it has been more a theory than anything else. In fact, the whole problem appears to be incapable of solution particularly if the individual villagers' predilection for the ancestral site is considered. In Orissa, Mooney, an officer of the Indian Forest Service, succeeded in bringing down certain groups of hill dwellers who were practising shifting cultivation to the foot of the hills, where ready made townships, complete with all facilities such as medical aid and hygiene, sanitation, water etc. and prepared permanent cultivation lands were ready for them. This uniquely successful experiment resulted in the abandoned *jhuming* land being given over to forest. But in the case of tribal peoples whose preference is for the mountain top--and in the case of Naga the tip of the top —this is a difficult solution to envisage even if there was sufficient flat land anywhere for permanent cultivation and consolidated settlements.

But there can be a new approach to this problem in view of the threat of diminishing wood supplies in India. While we hear a lot about fast growing plantations to produce industrial material for paper and pulp, hardboards, chipboards etc., and while every State is going in for afforestation with fast growing species like Eucalyptus, in many cases abandoning the growing of large sized trees on long rotations for small sized trees suitable for the production of industrial pulping material, the hills surrounding the Brahmaputra valley are producing in numerous plots, scattered over the whole length of the hills enormous quantities of cellulosic raw materials suitable for this type of industrialisation. Instead of trying to find land for these afforestation programmes in reserved forests which are already heavily burdened with demands for timber, firewood etc., we could utilise the material growing in these hills. By harvesting a part of the material which is burned—for not all the vegetation is reduced to ash nor is the whole of the tree needed for production of this type of natural fertiliser—this vast and readily available self-renewing, raw material resource can be tapped. In the middle of the *jhum* cycle say in the 5th year of the 10 year period (including the two years of cultivation), the coppicing grasses, reeds and fast growing species that have come up can be harvested once without any great diminution of the cellulosic material available for burning. After paying the cultivator a fair price for what is removed from his land the material can be taken to factories producing hardboards, chipboards and pulp situated in the plains within reasonable distance, say 20 to 25 miles, from railhead. In Nagaland where nearly one-third of the land area of 6000 square miles is under shifting cultivation, the possibilities for this are enormous. Even allowing for eventual 'stabilisation' of some of the *jhum* lands by terracing, growing of cash crops and afforestation, we can safely count on some 150 square miles (96,000 acres, say 100,000 acres) of such lands within easy reach of the railway—a strip of land 150 miles in length and 10 miles in depth—for production of cellulosic pulping materials. Allowing for one-tenth of this area being under cropping i.e., cutting and burning each year on a 10 year cycle, and on the basis of as low a figure as 5 tons of material per acre, we may expect 50,000 tons of such material per annum, sufficient for a hardboard plant of 100 ton capacity.

Application of this principle to other hill areas would mean that in a strip of hills surrounding the main Assam valley, the vegetation that comes up on the *jhum* plots can contribute to the establishment of a vast wood-products industry which can feed India with all the chipboard, hardboard and pulp and paper that it needs. It would mean the establishment of such industries in areas which are very poorly developed, while the tribal cultivator will earn money from his land and will be enabled thereby to improve his economic standard and way of life. He may even be able to finance the conversion of a portion of his land into terraces for permanent cultivation, thereby ensuring his future. Where the *jhum* cycle is long enough—say 10 to 12 years—the tribal cultivator could be induced, by a system of subsidies if necessary, to grow fast growing, coppicing species at suitable spacement (15′ to 20′) along with his cereal crops to supplement the vegetation which comes up in the inter-crop period, thereby establishing a self-renewing crop of wood for industrial utilisation. This is nothing but an adaptation of the *taungya* system of growing plantations with the aid of field crops, so well known to the forester in India.

This new solution for a chronic problem will serve three requirements: first, the need for amelioration of the system of *jhuming* by bringing about an increased return from the land, (as indicated in the last mentioned suggestion) because growing of trees instead of bamboos, grasses and reeds, will have a long term effect on the cycle through the provision of more ash from a *wood* burn as such; next, improving the economic status of the tribal cultivator, who has nothing to look forward to except poor crops won from the land by hard effort; and finally producing industrial material for India's needs. Such a solution is offered as a challenge, both to the hide-bound administrator and the conservative tribesman. Will it be taken up?

Observations on the Life History and Bionomics of *Oligotoma ceylonica ceylonica* Enderlein (Oligotomidae, Embioptera), commensal in the Nest of the Social Spider *Stegodyphus sarasinorum* Karsch.

BY

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(*With two plates*)

INTRODUCTION

None of the previous workers on social spiders has reported the commensalistic association between these spiders and the Embioptera living in their nests. Marshall (1898) discovered the presence of certain microlepidopteran nest mates of South African social spiders and Pocock (1903) reported commensalism between the social spiders and a moth *Bathrachedra stegodyphobius*. The association of the social spiders and Embioptera is a new record of commensalism. Since the literature shows that the life history and bionomics of even the free living Embiids have not been completely worked out and because all the developmental stages of *Oligotoma ceylonica ceylonica* are met with in the *Stegodyphus* nests, it was thought worthwhile to study the life history and bionomics of this Embiid as completely as possible.

METHODS OF STUDY

Social spider nests were collected from different areas in Feroke (Kerala State) near paddy fields at different periods of the year (Sep. 1964-Sep. 1965), and were dissected and analysed in the laboratory.

Live oligotomids were collected from these spider nests and some of them were reared in captivity in 2 in. petri dishes placed separately in beakers in a glass trough to which a little water was added to keep away ants, cockroaches, etc. The beakers were covered with a net to keep out any flying insects or arachnids.

The oligotomids in the petri dishes were provided with a little *Stegodyphus* nest material and dry twigs obtained from the interior of the nest. A little wheat flour was supplied to them now and then. The dry twigs were slightly moistened daily to maintain proper humidity. Daily observations were made on eggs, immature stages (nymphs), and adults under a stereomicroscope. Observations on the bionomics of *Oligotoma ceylonica ceylonica* were also made in the field on live nests of *Stegodyphus* late in the evenings, at a time when the spiders themselves are active.

LIFE HISTORY

Egg.—Oviposition takes place inside silken tunnels constructed by the mother. The total number of eggs laid by a single individual in its life time varies from 41 to 74 as calculated from the number of eggs laid by individual females in ten cultures in the laboratory, although under natural conditions the number appears to be much higher. The number of eggs laid per day varies from 1 to 3 although in one of the breeding cultures a female laid a total of 4 eggs per day several times. But usually only a single egg is deposited per day. The number of eggs which individual females are capable of laying is much higher in captivity than that recorded by Ananthasubramanian & Ananthakrishnan (1960) who believe that 'the number of eggs laid in captivity is always very limited' (6-15 in *O. minuscula,* 15-24 in *O. humbertiana*). Ling (1934) stated that 'each female of *O. saundersii* probably does not produce more than ten eggs'.

The eggs are deposited in a linear row, their opercular ends always directed anteriorly facing the roof of the tunnel, sometimes slightly overlapping each other (Plate I, fig. 1). If frequently disturbed they may lay without any such symmetry and arrangement, and deposit haphazardly on the inner surface of the silken tunnels. In *Stegodyphus* nests the eggs are laid in dry regions in the interior, where dark, humid, and favourable environmental conditions prevail. In captivity the egg-laying period varies from one to two-and-a-half months. The eggs are not laid continuously every day, as once or twice in a fortnight no eggs were deposited.

Each egg (Plate I, fig. 2) is more or less elongate, creamy white in colour, with a glistening surface when laid. The pear-shaped operculum is marked off from the rest of the egg by a thick whitish fold all along its margin. The average size of the egg is 0·89 mm. in length and 0·41 mm. in diameter.

Incubation period. 19 to 22 days, depending upon the period of the year. During development, the egg shows a slight change from white to opaque dull colour (due to the developing embryo inside) and later two rounded eye spots are visible through the chorion on either side of the opercular end, representing the eyes of the embryo inside.

First Instar Nymph (Plate I, fig. 3). The newly hatched nymph is pale-coloured and almost transparent. It can feed by itself, moves about actively, spins small tunnels and avoids daylight. It measures 1·4 to 1·5 mm. in length. The head is much wider than any other part of the body and measures 0·45×0·39 mm.; the thorax and abdomen are subequal in length. The eyes are blackish and the tips of the dentate mandibles are reddish brown. The head, shaped as in the figure, bears 9-segmented antennae which are nearly as long as the head. The first and second segments of the antennae are short and wide, 3rd segment long and rest of the segments as shown in the figure. The pro-, meso-, and metanota are subequal; the abdomen is 10-segmented, but the 10th segment is not clearly marked from the rest of the abdomen.

The fore tarsi of the nymph are swollen and contain spinning glands. The last pair of legs has a single metatarsal sole, bladder-like as in the adult. Cerci two-segmented, symmetrical, 1st segment smaller in length than the second segment. The body is wholly covered with pale-coloured setae, which are shorter on the antennae and longer on the cerci. The first instar moults into the second instar after 9-12 days. Just prior to moulting it measures *c*. 2·5 mm. in length.

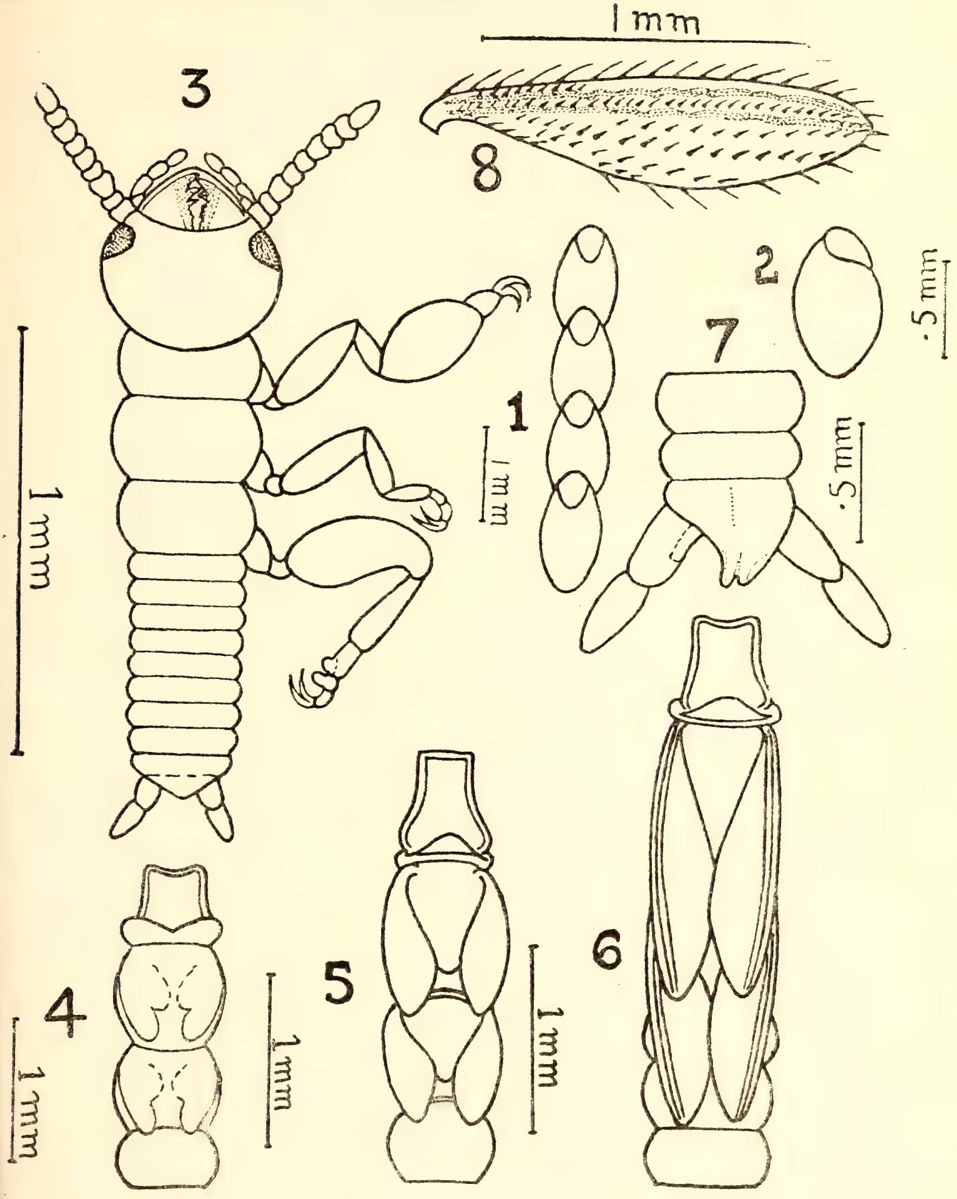
Second Instar Nymph. Pale-yellowish in colour measuring 2·8-3·6 mm. in length, with head 0·56×0·45 mm., thorax 1·18-1·41 mm., and abdomen 1·24-1·54 mm. This nymph differs from the first instar nymph in having a 12-segmented antenna, which is distinctly longer than its own head. It has 10 distinct segments in the abdomen; prothorax is narrower; 10th sternum divided into two parts by a median groove. Antennae, maxillary and labial palps, and legs are still pale-coloured. No sexual dimorphism is noticed in this stage. The second instar nymph moults into the third instar after 10-12 days. Just prior to moulting it measures *c*. 3·5 mm. in length.

Third Instar Nymph. The third antennal segment of the second instar nymph divides into two segments, and thus the third instar possesses a 13-segmented antenna. The antenna in this instar is about twice as long as its own head. The fourth and sixth segments of the antenna are the smallest in length. The male nymphs have small wing buds (Plate I, fig. 4) which are absent in the female nymphs. Only the tips of the wing buds are clearly visible. The wing buds in *O. ceylonica ceylonica* appearing in the third instar nymph thus develop at a very early stage in the life history as compared with the other species of *Oligotoma* studied. The nymphal stage with wing pads has been reported to be the 5th instar, both in the case of *O. humbertiana* (Ananthasubramanian 1956) and of *O. minuscula* (Ananthasubramanian & Ananthakrishnan 1960). The nymph is slightly pigmented and measures 4·18-5·50 mm. in total length. Its thorax is 1·5-2 mm. in length and the abdomen 1·9-2·9 mm. After about 10-13 days the third instar moults into the 4th instar nymph.

Fourth Instar Nymph. 5·5-5·8 mm. in length and about twice as long as the second instar. The head is 0·84×0·67 mm.; thorax 2·1-2·2 mm., and abdomen 2·6-2·7 mm. The cerci are symmetrical. Antennae 1·35 mm. long and 15-segmented as a result of the division of the 3rd antennal joint of the previous nymph into 3 segments, prior to moulting. Basal part of each antennal segment exhibits accumulation of light-brownish pigments in the form of a ring. Wing pads (Plate I, fig. 5) have grown in size and are completely visible measuring 0·56 mm. in length. They are dirty-white and are covered with loosely arranged setae. The 8th sternum of the female nymph shows a round unpigmented area where the female genital opening appears in the next instar. After 13-15 days the 4th instar moults into the 5th instar.

Fifth Instar Nymph. Pale-brown in colour; length varies from 5·15 to 6·66 mm. The male nymphs are usually smaller than the females and have more slender body. The male head measures 0·84×0·67 mm. and female head 0·96×0·84 mm. In the male nymph the wing pads have grown considerably in size and have become membranous. They bear linear rows of setae which demarcate the future veins. The anterior pair of wing pads extend up to the anterior margin of the first abdominal segment and the posterior pair to the anterior margin of the 3rd abdominal segment (Plate I, fig. 6). Each wing pad measures 1·2-1·4×0·39 mm. Two marginal pigment lines very near to each other run along the outer margin of each wing pad. Similar marginal lines have also been found in the wing pads of the male nymph of *O. texana* (Mills 1932). He believes these pigment lines to be the forerunners of the brown lines which are found on each side of the R_1 vein in the fully developed wing.

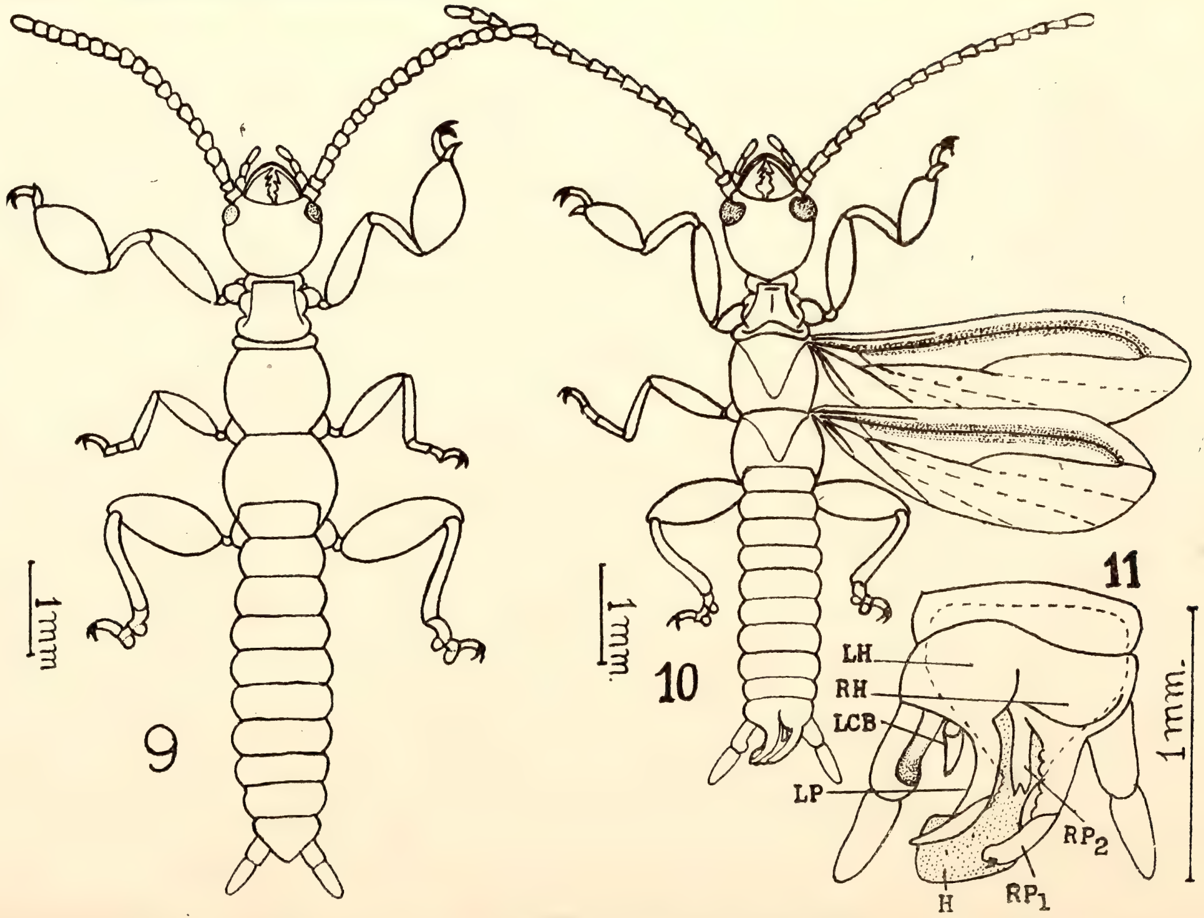
Bradoo: *Oligotoma ceylonica ceylonica*



Oligotoma ceylonica ceylonica Enderlein

Fig. 1. Alignment of 4 eggs as seen from above; Fig. 2. Sideview of an egg with operculum at the anterior end; Fig. 3. The newly hatched nymph; Fig. 4. Thorax and first abdominal segment to show early stage in the development of wing (in 3rd instar nymph); Fig. 5. Same at a later stage (in 4th instar nymph): Fig. 6. Same in the 3rd stage of development (as seen in 5th instar nymph); Fig. 7. Distal end of the abdomen of a grown up 5th instar male nymph; Fig. 8. Fourth stage in the development of wing (as seen in a later stage nymph);

Bradoo: *Oligotoma ceylonica ceylonica*



Oligotoma ceylonica ceylonica Enderlein

Fig. 9. Adult female; Fig. 10. Adult male; Fig. 11. Terminalia of male; H : Hypandrium; LCB: Left Cercus-basipodite; LH: Tenth left hemitergite; [illegible] RH: Tenth right hemitergite; [illegible] of the right hemitergite; RP₁: Inner process of the right hemitergite.

Antennae in both sexes 16-or-17-segmented, measuring 1·7-1·9 mm. in length. In the female nymph the genital opening is visible on the 8th sternum. In a grown-up male nymph the 10th tergum which is asymmetrical, shows a median depression and its tip bears two projections (Plate I, fig. 7) representing the two developing processes of the right and the left 10th hemitergites. These features, however, are transitory and after 10-13 days striking changes are noticed in antennae, head shape, mandibles, cerci, size and pigmentation of the whole body, 10th tergum and wing pads. The wing pads become thick and plate-like with distinct rows of setae, and the marginal pigment lines (already mentioned above) are seen wide apart from each other, running irregularly towards the tip of each wing-pad (Plate I, fig. 8). On the other hand the female nymphs attain maturity and grow larger in size without undergoing any of the changes mentioned above in the case of the male, except in the antennae and the general pigmentation of the body.

The nymphs make thick-walled tunnels and move very little now. Prior to the final moult which takes place within 3-5 days the male and female nymphs measure 5·4-6·7 mm. The total duration from the beginning of the fifth instar nymph to the final moult lasts 13-20 days.

Adult. The number of segments in each antenna of both sexes varies from 19 to 20. The measurements are as follows: MALE (Plate II, fig. 10) total length 6·2-6·31 mm., head 0·9×0·7 mm., anterior wing 4·5-4·6 mm., posterior wing 3·6-3·8 mm.; FEMALE total length 7·4-7·9 mm., head 0·96-1×0·8 mm. The female *O. ceylonica ceylonica* (Plate II, fig. 9) is larger in size and has much darker-brown coloration and a broad oval head. Its antennal segments are shorter in length. According to Davis (1940) 'adult male *O. ceylonica ceylonica* is recognisable by the first segment of the left cercus being less excavate in the basal three quarters and by the absence of the outcurved spine on the left cercus-basipodite'. The terminalia of the adult male of *O. ceylonica ceylonica* is shown in Plate II, fig. 11.

BIONOMICS

Habits. *Oligotoma ceylonica ceylonica* is nocturnal in habits like its spider host. It lives in sub-societies inside silken tunnels, which are constructed in the interior of the spider nest. These tunnels traverse the nest in the form of a network along the intercommunicating tunnels of the spiders. These silken tunnels of oligotomids communicate with the external environment through short branches spun on the surface of the nest and are provided with several small exit holes. The outer tunnels present on the surface serve as exits, especially for the adult males who fly away soon after copulation. They also lead to the green algal growths (on the exterior of the spider nest) serving as food for the nymphs. Sometimes, from the interior of the spider nest these silken tunnels penetrate into hollows of the wooden supports on which *Stegodyphus sarasinorum* construct their nests.

Sex ratio. Twenty-eight *Stegodyphus* nests analysed in different periods of the year yielded in all 203 oligotomids, consisting of 7 adult males, 28 adult females, 44 male nymphs, and 124 female nymphs (including many 1st and 2nd instar nymphs). Besides, a large number of eggs were also collected. All these nests were taken from Feroke (Kerala State) from the fencing around paddy fields. The maximum number of individuals collected from a single nest was 39. The adult males are very rarely found in the nest because, as stated above, they fly away soon after copulation. A correct assessment of the sex-ratio, therefore, can be made only from a count of the sexes taken in the nymphal stages soon after sex differentiation has taken place.

Copulation. The females become mature in the 5th instar even before the final moult, thus protogyny is the rule in *O. ceylonica ceylonica.* Copulation takes place inside the silken tunnels and has been briefly described by Melander (1903) in *Embia texana.* My observations confirm his studies. A day after copulation the female started oviposition. The fertilized female chases away approaching adult males from near her eggs. An unfertilized female was seen to extend its silken tunnels and to make many exit holes. This female survived for seventy-two days and did not lay any eggs.

As the eggs and immature stages of *O. ceylonica ceylonica* were available throughout the year, there is sufficient reason to believe that this species breeds all through the year. Ananthasubramanian & Ananthakrishnan (1960) reported a similar observation on breeding in *O. minuscula.* Since the life cycle is completed within 55-72 days in *O. ceylonica ceylonica,* it may be concluded that there may be 4 to 6 generations in one year. In *O. humbertiana* life history is completed within 111 to 158 days and in *O. minuscula* within 72 to 101 days (Ananthasubramanian & Ananthakrishnan 1960). The number of generations of these two species, when calculated, will be about 2 and 4 generations respectively. For *O. texana,* Mills (1932) reports only one generation a year. The breeding of *O. ceylonica ceylonica* throughout the year and the existence of 4 to 6 generations in the year may be ascribed to the abundance of food and other favourable conditions which are available to it in the nest of the social spider *S. sarasinorum*.

Maternal Care. The care and solicitude that the mother gives to her eggs and brood is well known. The eggs of *O. ceylonica ceylonica* are protected and concealed by a thin silken covering woven over them by the mother, over which she places bits of dry wood particles cut by means of her mandibles. In addition, black waste material from the spider nest and her own black ball-shaped faeces are placed over them, so that the eggs are practically concealed. Throughout the incubation period, the mother keeps guard over the eggs, very often touching them with her antennae. If the eggs are artificially exposed, she rushes to the eggs and hides them underneath her own body, standing over them. She then collects waste material and deposits them over the eggs, and later a silken webbing is swiftly added over the layer of waste material.

This habit of concealment of eggs may help to prevent fungal growth on their surface and at the same time may serve to conceal them from the eyes of the other individuals (of the same sub-society). Further, if the eggs are artificially placed outside on the silken tunnel, they are taken back inside and concealed once again. The newly hatched nymph, as well as other immature stages (mostly second and third instar nymphs) of the brood follow the mother throughout the tunnel, as in the case of a female with its brood of 26 individuals (consisting of three different instars), which I had maintained in my rearings. It was further observed that the newly hatched nymph followed the mother more closely than the older nymphs.

Egg parasites. The eggs of *O. ceylonica ceylonica* are parasitized by a minute wasp of the family Scelionidae (Hymenoptera). One parasite develops inside each parasitized egg. A similar wasp parasite has been reported by Imms (1913) from the eggs of *Embia major*. The parasite was observed by me to oviposit on fresh oligotomid eggs soon after it came out of the egg, and was seen to move freely inside the silken tunnels.

Dispersal. It has regularly been observed by me that the third, fourth and fifth nymphal instars of both the sexes actively go on extending the tunnels from their home nest to neighbouring nests of *Stegodyphus sarasinorum*, where they establish new sub-societies. During this extension these nymphal stages work inside silken tunnels which protect them from *Stegodyphus*. The adult females and males have not been found to be in any way responsible for dispersal. It seems that only the 3rd, 4th and 5th nymphal instars of both sexes are alone the founders of new sub-societies.

SUMMARY

Although the life histories and bionomics of a few oligotomids have been studied by some authors, detailed observations are lacking. The commensalistic association of *Embioptera* with social spiders is recorded here for the first time. There are 5 nymphal instars in the life history of *O. ceylonica ceylonica,* and sex-dimorphism appears first in 3rd nymphal stage. The life cycle is completed within 55 to 72 days and from this the number of generations per year is calculated as from 4 to 6. It is observed that the duration of the life history is shorter and the number of generations more in this oligotomid than in other species of the genus studied by previous authors. This is accountable only in the light of the benefits derived through the commensalistic association with the social spider *Stegodyphus sarasinorum.* Observations on bionomics of this oligotomid have been made.

ACKNOWLEDGEMENTS

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A special fishing method for *Mystus* (*Osteobagrus*) *seenghala* (Sykes) and *Mystus* (*Osteobagrus*) *aor* (Hamilton) and certain other interesting fishing methods in River Narbada

BY

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(*With three plates*)

INTRODUCTION

While engaged in fishery survey of River Narbada, an indigenous fishing method, locally known as 'Chir', was observed to be prevalent in the vicinity of Hoshangabad. It is an ingenious and specialised fishing device, for catching two commercially important species of catfishes *Mystus* (*Osteobagrus*) *seenghala* (Sykes) and *Mystus* (*Osteobagrus*) *aor* (Hamilton), locally called 'Digar' or 'Seenghar' and 'Kohora' respectively. This fishing method reportedly in use in River Narbada from time immemorial is now prevalent in certain fishing villages along the entire course of the river, but its practice is restricted to a few fishermen families. Near Hoshangabad, only two families are skilled in catching 'Digar' and 'Kohora' by this fishing method.

As 'Chir' fishing has not been hitherto described from any part of India, the fishing implements and the method of this type of fishing are described in detail. Other fishing methods employing scare line are also described.

'CHIR' FISHING

(*a*) *Fishing gear :* The equipment and the accessories required for 'Chir' fishing are a scare line, three wooden poles, two small boats and a fishing hook.

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(i) *Scare line* (Local name: 'Dor') consists of about 500 yards of rope, generally made from Shunn-hemp (*Crotalaria juncea*) and sometimes from 'Kans' (*Saccharum spontaneum*); several bunches of long and narrow leaves of a grass (Local name: 'Orai'), each about 10 inches long; several small pieces of stone; and about four floats, generally of 'tumbe'.

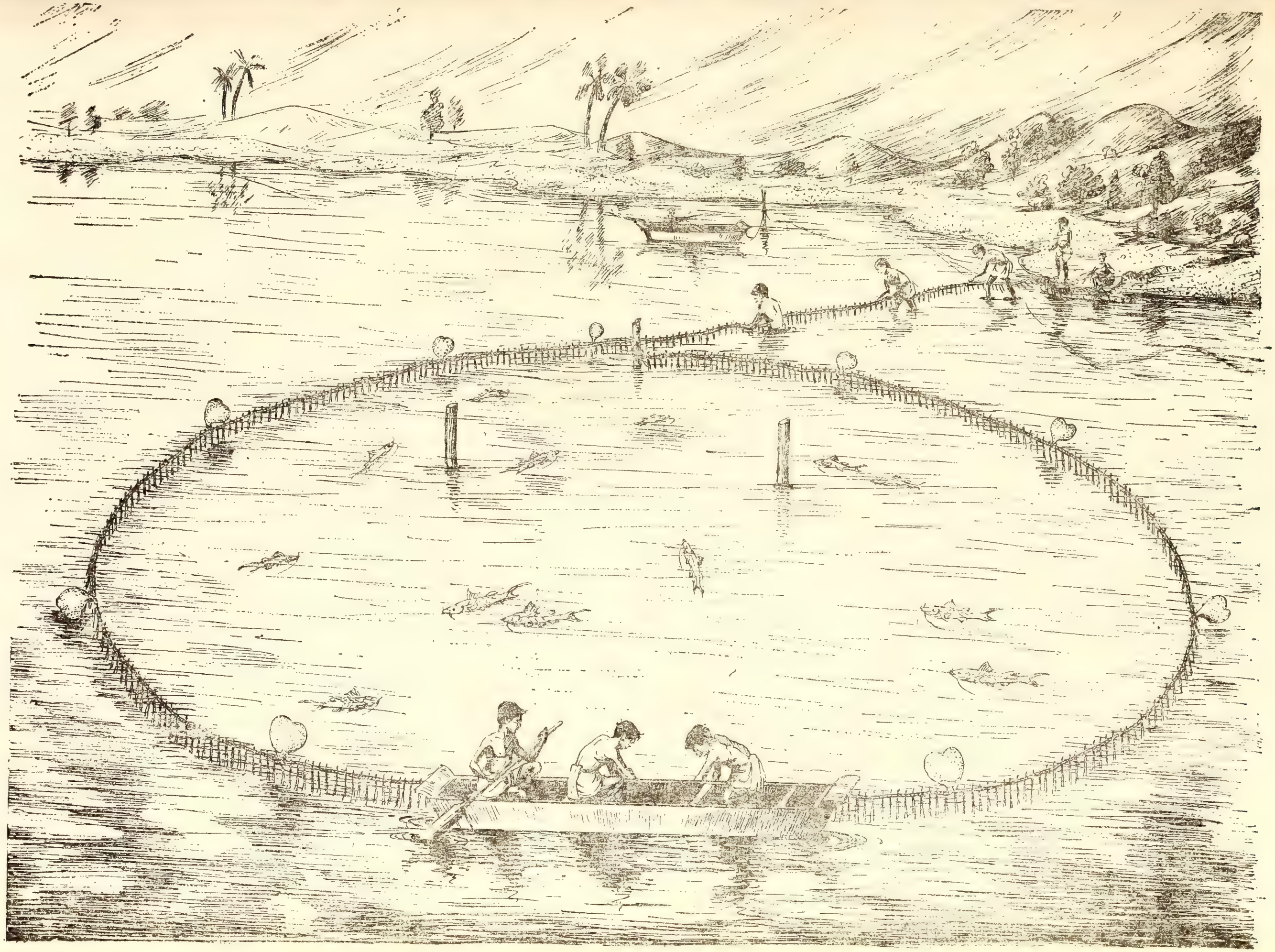
The bunches of 'Orai' are inserted in between the strands of the rope at regular intervals of 6 to 8 inches and small pieces of stone are tied close to the rope with ordinary thread (usually 'Sutli') at regular intervals of about 20 inches i.e. after every third bunch of 'Orai'. The four floats are tied to the rope at intervals of about 100 yards. This line is dragged through the water to scare the fish into the enclosure formed by it. During the course of dragging, the bunches of 'Orai' hanging from the rope form a flimsy wall through which 'Digar' and 'Kohora' do not escape but congregate in the middle of the enclosure. The small stones tied to the rope act as sinkers. The floats help to keep the scare line in position and from sinking to the bottom and also help in tracing the submerged scare line.

(ii) *Wooden poles* (Local name: 'Khootte'): Three straight poles generally of 'Sal' wood (*Shorea robusta*), each measuring 8 to 10 feet in length, are required for this type of fishing. They are fixed in the sandy river bed in the form of a triangle. The scare line finally rests against these poles, forming a triangular enclosure.

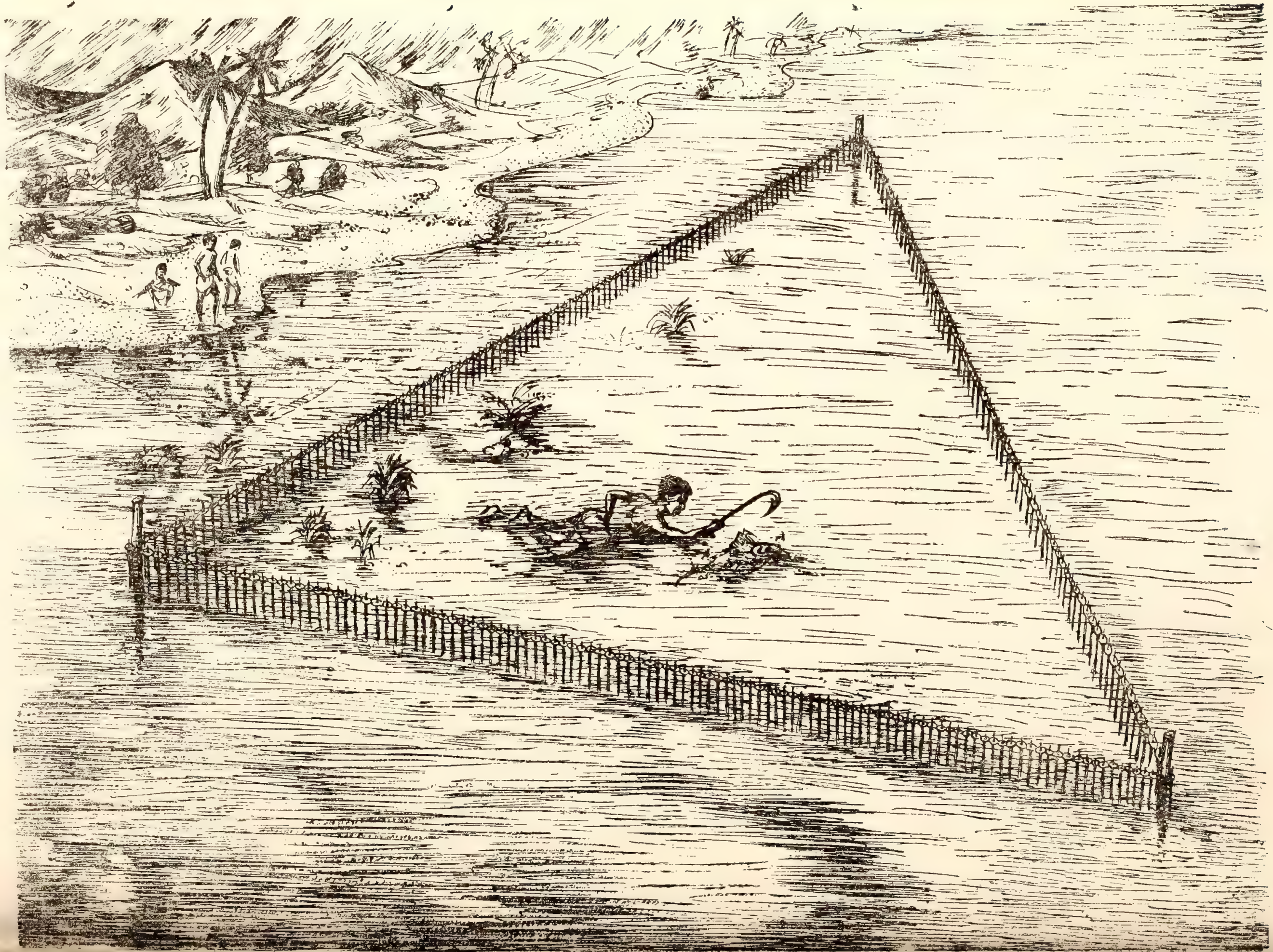
(iii) *Small boats* (Local name: 'Donga'): The small boats ordinarily used for other types of fishing in the river are also employed in 'Chir' fishing. They are small-sized, plank-built and with flat bottom, about 20 feet in length and about 3 feet in width. Two such boats are generally used, one for feeding the scare line into the water and encircling the fishing area and the other to prevent the scare line from entangling in submerged weeds, rocks or boulders, while it is being dropped in or dragged through the water.

(iv) *Fishing-hook* (Local name: 'Gaal'): The hook employed is similar in shape to an ordinary fishing hook, but is larger in size and has a long shaft suitable for a firm grip. It is made from a $\frac{1}{4}$ inch diameter iron rod. The shaft measures 16 to 20 inches in length and has an eyelet at one end and the barb at the other. A thin and short piece of rope is passed through the eyelet and tied in a closed loop. The hand is slipped through the loop before gripping the shaft of the hook, to ensure that it does not slip off at the time of fishing.

(b) *Number of fishermen required:* Usually six fishermen are required, but sometimes even four or five fishermen manage the whole fishing operation. They operate in two parties, each of two



Laying the 'scare' line for chir fishing



to three fishermen in one small boat. One boat feeds out the scare line and the other boat tends it. One fisherman of each party manipulates the boat, one feeds out the scare line and another, the skilled fisherman, hooks the fish but he also helps in feeding out the scare line if it becomes necessary. The two fishermen of the second boat tend the scare line as it is being dropped in water and dragged.

(*c*) *Fishing operation* (Plate I): After locating a suitable fishing area, the three wooden poles are fixed in the sandy river bed where the depth of water varies from 4 to 5 feet. The three poles are fixed in a triangle at a distance of 30 to 40 feet from each other. One end of the scare line is tied, about a foot below the water surface, to the pole near the river bank and rest of the scare line is loaded on the boat, which moves away from the river bank, dropping the scare line outside the two other poles and enclosing as much area as the length of the scare line permits. The free end of the scare line is then brought to the river bank and dragged very close to the pole to which the scare line is tied completing the enclosure. As the scare line is dragged and the enclosed area narrows, the frightened fish move and gradually congregate in the hind portion of the enclosure. One boat with three fishermen guided by the floats moves towards the line and ensures that the line is not entangled by submerged obstacles, till the line finally rests against the poles. The fisherman armed with the hook then gets inside the enclosure holding the fish and dives in search of them (Plate II). When a fish is located, he strikes with the hook keeping himself at arm's length and pulls the fish towards him carefully so that the fish does not injure him during the course of its struggle.

(*d*) *Time and season of fishing:* For successful fishing by 'Chir', good visibility inside the water is essential to enable the fisherman to locate the fish and hook it successfully. The fishing is, therefore, practised generally from mid-October to mid-June, when river water is clear, and vast stretches of the river become shallow and suitable for this type of fishing. 'Chir' fishing is done usually from 10.00 a.m. to 4.00 p.m. but the best time for fishing is from 11.00 a.m. to 2.00 p.m., when the sun is directly overhead and there is maximum visibility inside the water. Moreover, during midday the danger of fish being frightened by the shadow of the fisherman is lessened. While fishing before 11.00 a.m. and after 2.00 p.m., the fisherman ensures that his shadow does not fall on the fish at the time of hooking by approaching the fish from the west during morning hours and from the east in the afternoon.

(*e*) *Selective fishing:* The fishing area through which the scare line is dragged contains all types of fishes, but during the dragging of the scare line all other fishes escape through the flimsy 'Orai' barrier or jump over it. 'Digar' and 'Kohora' remain in the enclosure evidently because they are not capable of jumping over the scare line. These two species of catfishes also do not attempt to break through the barrier probably because the bunches of 'Orai' touching their body, gives the impression of an insuperable barrier and keep on retreating as the scare line approaches them. On some occasions, however, when the fisherman fails to hook one of the catfishes and it breaks through the scare line, the remaining fish in the enclosure follow.

(*f*) *Fishery and size composition:* The two species of catfish are also encountered in the catches by other gears, like cast net, gill net and long line, along with other species of fish. The general observations on the catches of 'Digar' and 'Kohora' from 'Chir' fishing and other gears have, however, indicated some disparity in the proportions of the two species and in their size compositions. In order to get an exact idea of the relative abundance of these two species of catfishes and their size compositions in the catches of 'Chir' fishing and by other gears, the relevant data were collected separately for different fishing operations from November 1963 to April 1964. The data thus collected have been compiled and presented in the Table.

TABLE

SIZE COMPOSITION OF 'DIGAR' AND 'KOHORA' IN 'CHIR' FISHING AND BY OTHER GEARS FOR THE PERIOD NOVEMBER 1963 TO APRIL 1964

Size Range (mm.)	'Chir' fishing				Other gears (cast net, gill net and long line)			
	'Digar' No.	(%)	'Kohora' No.	(%)	'Digar' No.	(%)	'Kohora' No.	(%)
101- 200	—	—	—	—	—	—	16	(4·6)
201- 300	16	(6·4)	—	—	12	(5·4)	103	(29·3)
301- 400	9	(3·6)	2	(12·5)	27	(12·1)	67	(19·1)
401- 500	45	(18·1)	4	(25·0)	32	(14·3)	76	(21·7)
501- 600	62	(24·9)	6	(37·5)	35	(15·6)	38	(10·8)
601- 700	51	(20·5)	2	(12·5)	52	(23·2)	21	(6·0)
701- 800	31	(12·5)	2	(12·5)	39	(17·4)	25	(7·1)
801- 900	16	(6·4)	—	—	14	(6·2)	3	(0·8)
901-1000	7	(2·8)	—	—	6	(2·7)	2	(0·6)
1001-1100	11	(4·4)	—	—	6	(2·7)	—	—
1101-1200	1	(0·4)	—	—	1	(0·4)	—	—
Total	249		16		224		351	

The Table shows that 'Digar' outnumbers 'Kohora' in the catches of 'Chir' fishing and the reverse is the case with the pooled catches with other gears. The haulwise observations on the catches of 'Chir' fishing have revealed that while most of the hauls yield only 'Digar', a few specimens of 'Kohora' are also encountered in some hauls and when the pooled catches from all hauls of 'Chir' fishing during a period are considered, the two species are fished in the ratio of about 15:1 indicating that 'Chir' fishing is especially effective for catching 'Digar', whereas 'Kohora' is captured only casually by this method.

The length frequency data of the two species of catfishes taken by other gears indicate (Table) that the maximum size of 'Digar' (size range: 1101-1200 mm.) is larger than that of 'Kohora' (size range: 901-1000 mm.) in the Narbada, at least near Hoshangabad. Comparison of various size groups of 'Digar' in the catches of 'Chir' and those of the other gears shows that 'Chir' fishing does not exhibit any size selectivity and the various sizes of this species captured by 'Chir' are almost in the same proportion as in the catches of other gears. The sizes of 'Kohora' which are encountered in smaller numbers in the catches of 'Chir' represent the dominant size groups of the catches of the other gears.

(*g*) *Primitive origin:* 'Chir' fishing involving the use of scare line and hook is undoubtedly of primitive origin, based on the knowledge of the habits and the behaviour of fishes in nature and makes use of the timid nature and sluggish habits of 'Digar' and 'Kohora' catfishes for catching them. The professional skill required in 'Chir' fishing has been passed on from generation to generation but fishing by this method, like any other primitive fishing method, has dwindled considerably with passage of time and is not now practised on a large scale.

(*h*) *Superstitions associated with 'Chir' fishing:* Certain superstitions are reported to be associated with 'Chir' fishing:

(i) Religious rites are performed by the fishermen before starting 'Chir' fishing in each season commencing from mid-October. All the fishing implements particularly the fishing-hook and the scare line are worshipped by reciting 'mantras'. A chicken is also sacrificed in front of the fishing implements. The sacrificed chicken is eaten by the fishermen and their friends as 'Prasadam'. It is a deep rooted but unfounded belief among the fishermen that by worshipping the scare line, 'Digar' and Kohora' do not break through it.

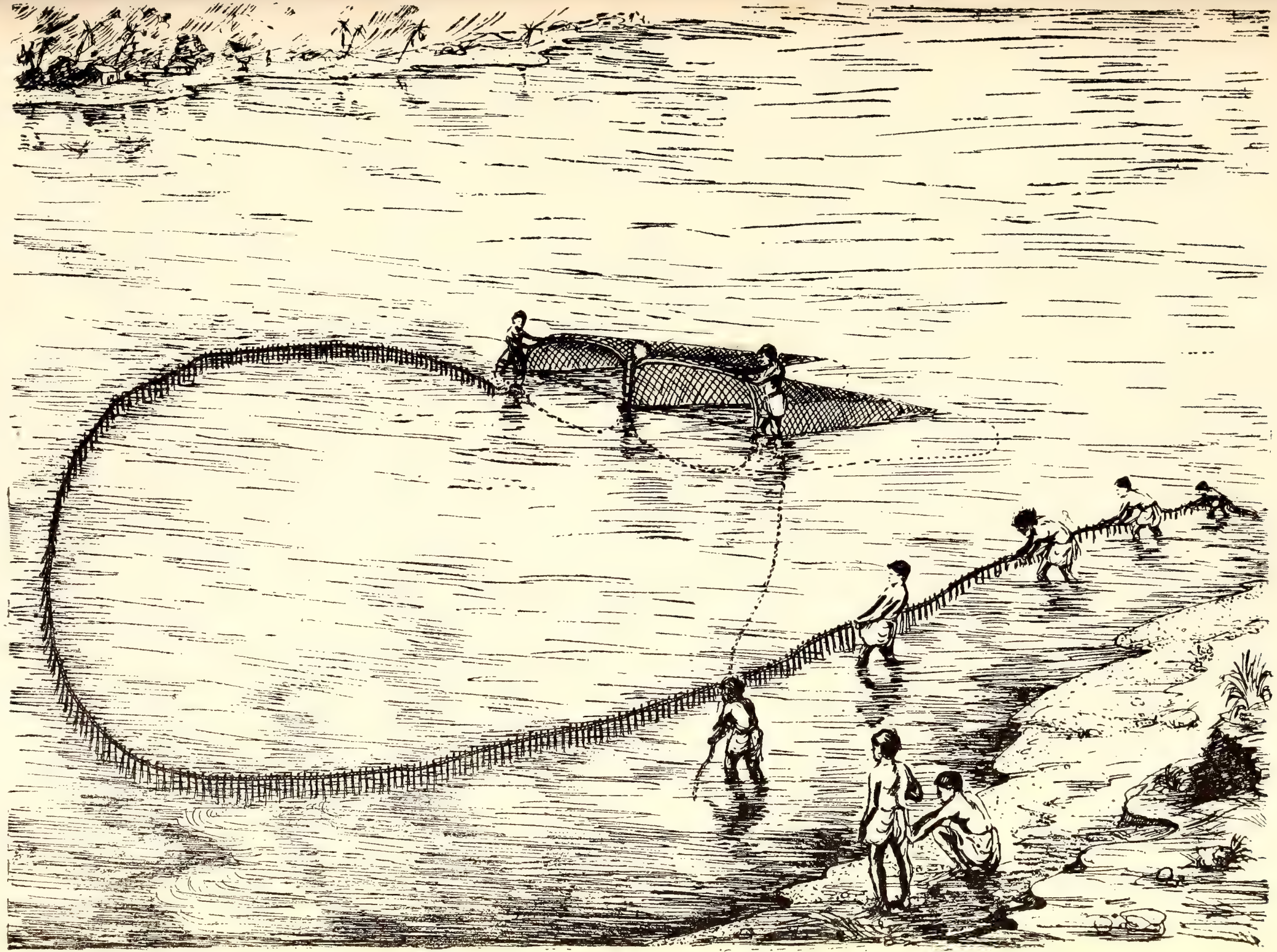
(ii) Before disposing of fish caught by 'Chir' fishing, their adipose fin is severed and viscera are removed. Under no circumstances, are they taken from the fishing ground without the observance of these ceremonial functions. The adipose fin and the viscera are either thrown into the water or cooked on the river bank and eaten. It is believed by fishermen that if intact fish or their adipose fin and viscera are allowed to leave the fishing ground, the 'mantras' will become ineffective, resulting in poor catches later.

(iii) It is believed by fishermen that the man who takes an active part in 'Chir' fishing and hooks the fish usually suffers from defect in one foot in his old age. This belief is based on actual happenings of such incidents.

OTHER FISHING METHODS EMPLOYING SCARE LINE

Gopinath (1953) has described a fishing method in the backwaters of Travancore, in which a rope fitted with coconut palm leaves is employed as scare line and the fish (*Eutroplus suratensis* and *Gerres* sp.) are grabbed by hand. In Narbada River, the use of scare line is also known in two more fishing methods which are described below. The gear employed in these fishing methods are nets which are used as traps.

(i) At Hoshangabad and other places on the river the fingerlings of large-sized fish like *Tor tor, Tor putitora, Labeo fimbriatus* and *Labeo dyocheilus* and the small-sized fish namely *Labeo bata, Cirrhina reba, Barbus sarana, Barilius bendelisis, Chela clupeoides* and *Danio* spp. are trapped in a composite net made of two cast nets, by dragging the scare line in shallow regions of the river (Plate III). In this type of fishing which is locally called 'sheer' or 'chheer' the scare line is comparatively shorter in length varying from 100 to 200 yards and instead of 'Orai' leaves the date palm leaves are used in the preparation of scare line. The method of this type of fishing is more complicated and quite different from that of 'Chir' fishing. In this method, two cast nets are sewn together along their circumference for some length and reinforced with a short piece of bamboo, so that the mouth of the composite net does not collapse during fishing operation. One 'tumbe' float is tied to the upper end of the bamboo piece in order to keep the mouth portion of the net floating. Two fishermen, one on either side of the composite net, hold the lower margin of the mouth of the net with the toes of one foot and the upper margin with both hands. One end of the scare line is tied to the free leg of one of the two fishermen holding the net, and rest of the scare line is laid in the water in semi-circular fashion and dragged towards the river bank by three fishermen. One end of another ordinary rope is, in turn, tied to the free leg of the other fisherman holding the net



'Sheer' fishing for fingerlings

and the other end of it is held by another fisherman. During fishing operation while the scare line is being dragged, the two fishermen holding the net move forward and at the same time the fisherman holding the ordinary rope beats the water surface violently by moving the rope sideways. Sometimes, in slight variation of this method, the composite net is kept stationary whereas the scare line is dragged and the ordinary rope is moved sideways in the water as described above. The fish frightened by the scare line try to escape across the ordinary rope, but due to the sound and vibrations created in the water by the beating of the rope the fish are diverted into the net and are trapped by closing the mouth of the net.

(ii) Another fishing method which is a modification of 'sheer' fishing is employed to catch the fry (1 to $1\frac{1}{2}$ inches) of two species of Mahseer, *viz.*, *Tor tor* and *Tor putitora* and small-sized fish like *Barilius bendelisis*, *Barilius barila*, *Barilius evezardi* and *Chela clupeoides*. This method is particularly employed in River Narbada at Hoshangabad and other places in Madhya Pradesh from November to March to catch Mahseer fry for stocking purposes. In this method, one drag net is operated in conjunction with the scare line. The drag net is made of an ordinary mosquito netting cloth and is of varying sizes, generally measuring 15 feet in length and 7 feet in width. The scare line is made of coir rope, fitted with date palm leaves and measures about 100 yards in length. After locating the shoals of fry, the scare line is laid in a semi-circle surrounding the shoals and dragged towards the river bank. The drag net held by two or more fishermen is then moved towards the approaching scare line and is lifted to trap the fry which enter the fold of the net. The Mahseer fry are also caught with drag net and scare line in a slightly different manner. The drag net is kept stretched in shallow water near the river bank and the scare line is then dragged towards the bank where the net is kept in readiness. When the shoals come over the drag net, the four corners of the net are lifted out of water trapping the fry.

ACKNOWLEDGEMENTS

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REFERENCE

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The Genus *Caryota* in India

BY

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(*With two plates, seventy-five text-figures and a map*)

INTRODUCTION

The present paper is the 8th contribution to studies on palms undertaken by the senior author (T. S. M.) and his associates[1]. It deals with the genus *Caryota* in India. This genus is mainly concentrated in Indo-Malayan region having about 17 species of which 7 occur in India, 4 wild and 3 cultivated. The taxonomy of the genus is rather confusing due to the scarcity of authentic material and hybridization in cultivated plants.

Previous workers on it have been Linnaeus (1737), Griffith (1850), Seeman (1856), Bentham & Hooker (1883), Nicholson (1885), Drude (1887), J. D. Hooker (1892), Cooke (1908), Gatin (1912), Bailey (1914), Brandis (1921), Blatter (1926), McCurrach (1960), Tomlinson (1960 a, 1960 b, 1961, 1962) and Moore (1960, 1960 a). Moore (1960) has proposed a new taxon for the sub-family Caryotoideae in the classification of the Palmae.

DIAGNOSTIC FEATURES OF THE GENUS *Caryota*

The plants grow singly or in clumps, their stem being distinctly annulated. A jacket of adventitious roots surrounds the stem a little above the ground. The leaves are large and bipinnate, so uncommon in palms, the pinnae being borne on secondary axes of the leaf. Their vernation is induplicate. A single pinna is multicostate, divergent and strongly pulvinated. Stomata lie on both surfaces of the leaf and are characterised by ridges or teeth on the guard cells. In some species multi-cellular hairs are also present on the lower epidermis of leaf.

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[1] For earlier contributions see T. S. Mahabale, & M. V. Parthasarathy, (1963) ; *J. Bombay nat. Hist. Soc.* 60 (2) : 371.

The peduncles are very large and massive. They have a stout primary axis from which hang several horsetail-like secondary branches, forming a bunch of pendulous spikes. The inflorescences develop basipetally, i.e., from the apex down towards the base of the tree, and this is a unique habit of Caryotoid palms.

Each inflorescence is a spadix (Plate II, figs. 7, 8) encircled by 8-9 spathes enclosing about 40 secondary branches each bearing male and female flowers together. Generally they are in groups of three, the central flower being female and the laterals male. The male flowers develop and ripen earlier than the female. They drop off after pollination and fruits set in on the secondary branches in spikes. At maturity no male flowers are seen on them. The flowers have perianth with trimerous parts. In female flowers there are 1 or 2 hemi-anatropous or anatropous ovules and 3 staminodes. In male flowers the number of stamens ranges from 17-100. So far no pistillodes were observed in the male flowers.

Fruit is a 1- 2-seeded, non-fibrous drupe. The seed is ruminated, its surface being much corrugated. The conical embryo is lateral, and germination of the seed is '*Remotive*'. The first eophyll is simple, multicostate and convergent (Plate II, fig. 12).

DESCRIPTION OF SPECIES

A. *Wild Species*

1. **Caryota urens** L.

(Plate I, fig. 1)

This handsome species commonly known as *Bherli Mad* throughout Deccan or *Kitul* or 'Fishtail palm', attains a height of 12-22 m. in rain forests. It yields sago from its pith and commercial bristle fibre from the base of the leafstalk. The fibre being highly resistant to sea water is widely used for making fishing nets. Its outer bark is greyish brown in old trees and gets peeled off as periderm.

The crown of leaves is made up of 6-10 large bipinnately compound leaves measuring 4-4·5 m. The triangular leafbase is covered with fibres. Pinnae are borne on secondary axes. There is an odd terminal leaflet which provides a specific character. Each pinna has a pulvinus at the junction of the secondary axis of a leaf. The leaf being very large is often bent in the middle. There are 18-25 secondary rachises, each bearing 36 pairs of leaflets or pinnae in the basal part, 14 in the middle part and 5 in the apical part. They are arranged in a pyramidal manner.

Each leaflet or pinna is multicostate and divergent. There is no definite midrib but only 5-6 large costae.

A T.S. of the leaf at the point of attachment of pinna to rachis is 'V'-shaped. The vernation of entire leaf in *Caryota* is induplicate as in the *Sabaleae*. A developing leaf appears as a sword-like structure, its pinnae being closely folded together upon the secondary axis. Margins of the pinnae are connected to each other by thread-like ash-grey reins, held together by means of a pointed hook at the apex of leaf as in *Phoenix*. As the pinnae get separated from the apex, reins break off and hang downwards.

A single pinna is 30×4 cm., ashy green in colour and has shining surface. It is triangular in shape and thick in texture. There is a waxy coating on the abaxial face of the leaf.

The primary rachis ends in a bifid leaflet. Just below the terminal leaflet there are side pinnae below which lie two small pinnae, which are called here as the 'associated pinnae' to differentiate them from the side pinnae. The terminal leaflet is 22×8 cm., side pinnae 22×6 cm., and the associate pinnae 15×5 cm. There is also a terminal leaflet on the secondary axis, 23×40 cm. It also has side pinnae, 17×2·5 cm.

The inflorescence in this species is about 75 cm. long, completely enclosed within large boat-shaped spathes. The adult fruiting axis when out of spathe is 300-360 cm. in length, having a thick cylindrical primary axis with 40-42 secondary branches, the fruitiferous spikes (Text-fig. 53). They hang down in a thick cluster and hence the popular name, 'Horsetail palm'. The male flowers are 1·5 cm. long and sessile. They have two rudimentary bracts and 3 sepals each. The latter are imbricate, round and coriaceous and have frilled edges (Text-figs. 39-40). Petals 3, larger than sepals, pinkish, valvate. Stamens 40, acuminate, with short filaments. Anthers long and basifixed. Pollen grains are monocolpate, reticulate and 24×13·2 μ in diameter.

Female flowers, situated between two male flowers all along a spike have 2 scaly bracts and 3 ovate, concave and closely imbricate sepals (Text-fig. 41). Petals 3, round, ciliate and valvate, forming a persistent tube. Ovary superior, subtrigonal and has two anatropous ovules. Stigma sessile. There is a basal nectary. Fruit is a 2-seeded drupe, 1·3-1·4 cm. in diameter. The seeds have corrugated surface. Multicellular hairs are present on the seed coat.

Endosperm is ruminated. Its cells are porous. Epicarp is single-layered. A row of sclereides lies below the epicarp. The mesocarp is spongy and full of raphide sacs. Air cavities and tannin containing cells occur in it. The endocarp is generally few-layered. Seed coat is many-layered and full of tannin.

Germination of the seed is of the '*Remotive*' type. The first eophyll is simple, multicostate and convergent.

Habitat. Deciduous forests of Deccan, Konkan, Madras, Coimbatore, Central India, Orissa, evergreen forests of North Kanara, Malabar, Nilgiris, Sub-Himalayan regions, up to 2051 m. in Nepal. It is largely cultivated in gardens all over India, Middle East and elsewhere, often from unknown sources, for its beauty.

2. **Caryota rumphiana** Mart.

(Plate I, fig. 2)

This elegant palm 24-25 m. high is the tallest species of *Caryota* among those studied. Its single stem is distinctly annulate, with bark cracked into longitudinal slits. The towering crown of leaves is made up of 6-14 leaves, each measuring 5-6 m. The texture of pinnae is very thick and leathery compared to that in other species. The terminal leaflet of the primary axis of rachis is bifid. It measures 35×10 cm. The side pinnae are 32×5 cm. long. The terminal leaflet on the secondary rachis is 20×7 cm. and is without a tapering apex. The side pinnae are 17×7 cm.

The spadix is 12-14 cm. long and arises at right angles to the main axis of the tree, bearing about 45 pendulous spikes (Text-fig. 52). It is similar to that in *C. urens*, but the fruiting secondary axes are huge, 360-420 cm. long and are the largest among the inflorescences of species studied.

The male and female inflorescences are similar to those in *C. urens* and have long but thin perianth. The number of stamens in male flowers is 24. The fruit 1·6 cm. in diameter, is larger than that in *C. urens*. The epicarp consists of compactly arranged cells and 2-3 rows of sclereides. The mesocarp is multi-layered and has raphide sacs and tannin cells. The endocarp is papery and single-layered. The seed coat is filled with tannin. Surface of the seed is corrugated. The endosperm is ruminated, ruminations being heavily impregnated with tannin. Embryo is conical and lateral. Germination is of the '*Remotive*' type as in *C. urens*. Eophyll is simple, multi-costate and convergent.

A variety of this species grows in the Empress Gardens, Poona, which has 30 stamens instead of 24 in the male flowers and has highly ruminated seeds.

Habitat. This grows wild in Dandeli forests of North Kanara. It is cultivated in gardens, e.g., in J. J. School of Arts, Bombay, Empress Botanical Gardens, Poona, etc. It is found wild in Malay Archipelago, New Guinea, Borneo and North Australia.

3. **Caryota obtusa** Griff.

This palm has the same habit and stature as *C. urens*, but it can be recognised from it by the rounded, crenate apex of its leaflets. The male flowers are short and unexpanded. The number of stamens in male flowers is indefinite. It is a palm of high altitude.

Habitat. Wild in Upper Assam and Mishmi Hills, and is sometimes cultivated in gardens.

4. **Caryota sobolifera** Wall.

(Plate I, figs. 4, 5)

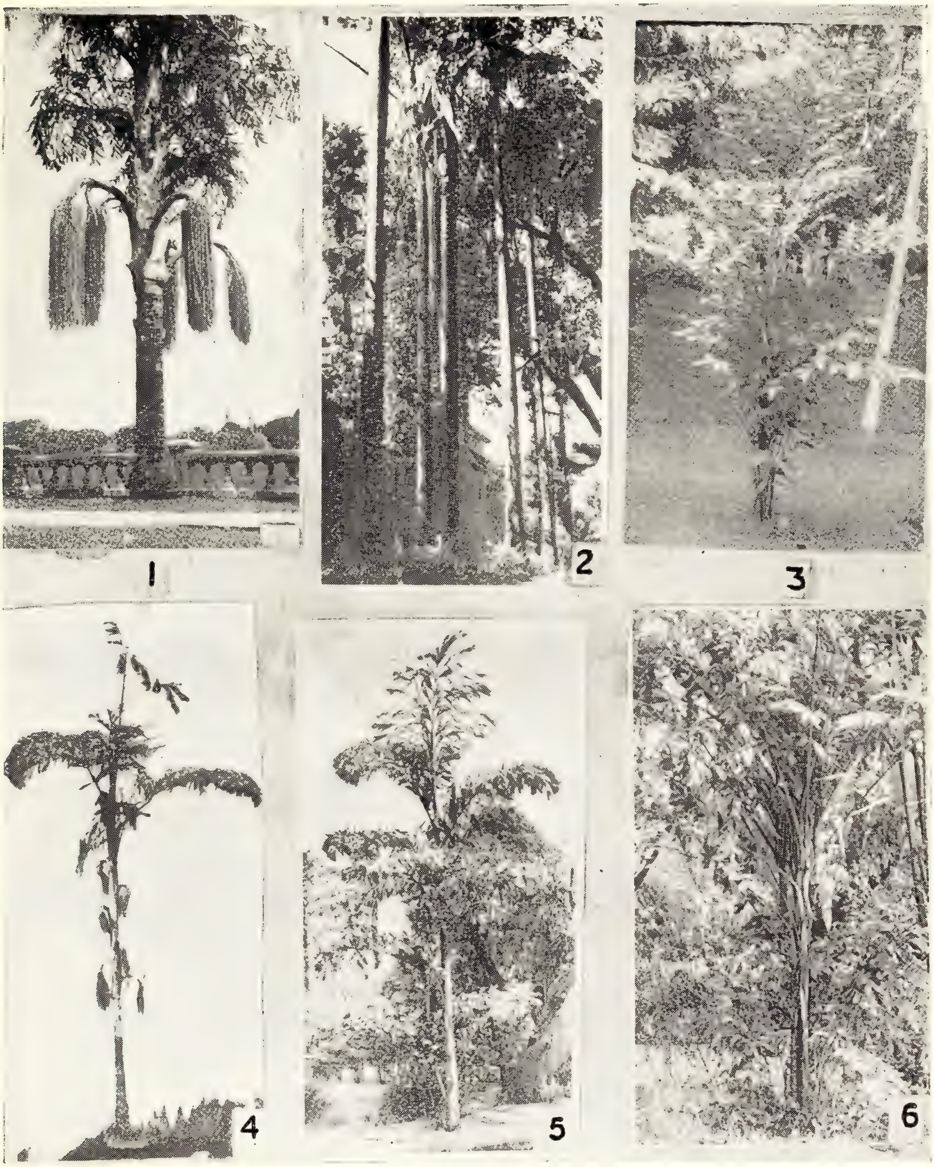
This is an ornamental species. It has one or two young shoots sprouting from below the base of the tree trunk, almost at ground level. Stem annulate. Adult plants attain a height of 10·5 m. The leaves are bipinnate, their crown being made up of 6-16 leaves. Each leaf is 2·1-2·4 m. long. The secondary axes bearing pinnae on a primary rachis of leaf are 14-25.

The number of pinnae is 5 in the apical region, 14 in the middle, and 36 in the basal region. A single pinna measures 10×2·5 cm. with 5 main costa ending in teeth.

The terminal leaflet of the primary axis of a leaf measures 18·0×14·0 cm. and has a deep incision. The side pinnae and the associated pinnae have central projection. Side pinnae are 18·0×6·0 cm. and the associated pinnae 9×3 cm. The terminal leaflet of the secondary axis is not tapering and is 17·0×18·0 cm. The associated pinnae measure 13·0×3·0 cm.

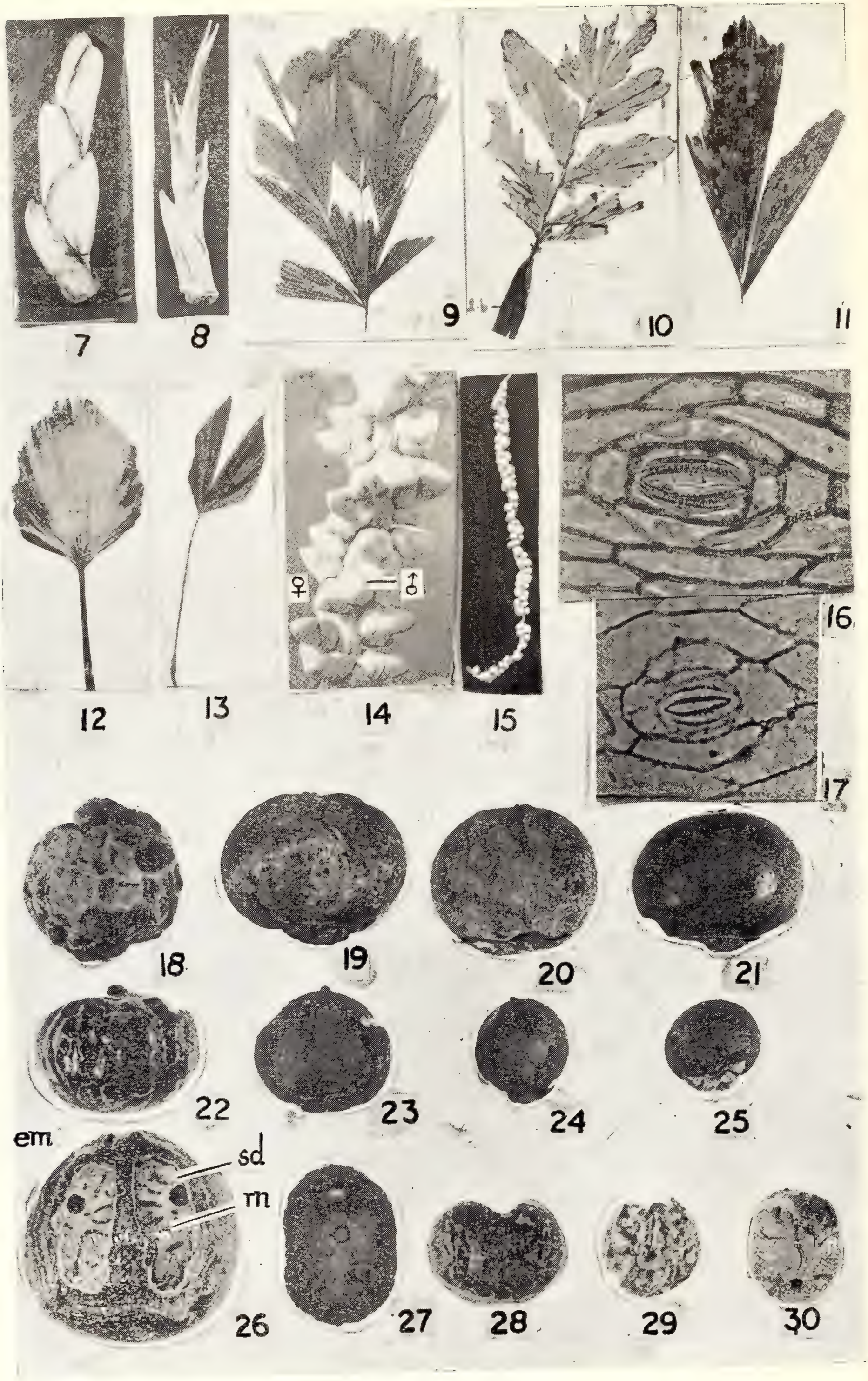
The inflorescences arise basipetally as in other species (Text-fig. 54), but the arrangement of flowers is quite different in this species. They lie in groups of two, one male by the side of one female flower at each juncture (Text-fig. 50). The male flowers are much curved in bud and have 2-3 staminodes each. Some hermaphrodite flowers are

Mahabale: Genus *Caryota*



Caryota species in India

1. *C. urens* L. (growing in Municipal Garden, Hyderabad), 2. *C. rumphiana* Mart. (growing in J. J. School of Arts, Bombay); 3. *C. plumosa* Hort. (growing in Royal Botanical Gardens, Peradeniya, Ceylon); 4 & 5. *C. sobolifera* Wall. (growing in B. Sahni Institute, Lucknow); 6. *C. mitis* Lour. (growing in Empress Botanical Gardens, Poona).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Morphology of leaf, inflorescence, fruit and seeds in *Caryota*
(For figure captions see page opposite)

also found in this species. The number of stamens per male flower is 17-21. The ovary is superior and bicarpellate.

Habitat. Upper Assam, Malaya; also cultivated in gardens, e.g., at the Birbal Sahni Institute of Paleobotany, Lucknow; Poona University Botanical Gardens, Poona etc.

B. *Introduced Species*

5. **Caryota mitis** Lour.

(Plate I, fig. 6)

This species is commonly grown in gardens for its bushy habit. New shoots arise from the axillary buds very close to earth from the base of the tree, or even from the portion a little below the ground. It attains a height of 7·5 m. The leaves are bipinnate, each pinna being without any long apical projection. Length of the leaf is 0·9-1·2 m. The leafbase is triangular. A pinna measures 17·0×5·0 cm. The terminal leaflet of the primary axis is 13·0×12·0 cm. with two side pinnae. The number of pairs of pinnae on the secondary axes of leaf is 5 in the apical region, 4 in the middle region and 6 in the basal region. The terminal leaflet of a secondary axis is 20·0×8·5 cm. and has tapering apex. The associated pinnae are 11×5 cm.

The inflorescences are intrafoliar and arise basipetally. They arise even at the lowest node of the tree trunk at the ground level. The spadix has a beak-shaped apex and 8 spathes. It bears about 30 spikes (Text-fig. 51). The arrangement of male and female flowers here is the same as in *C. urens*.

Morphology of leaf, inflorescence, fruit and seeds in Caryota.

7, 8. Spadix in *C. mitis* and *C. urens* respectively. 9. *C. sobolifera*. Terminal leaflet of the primary axis of leaf. 10. *C. mitis* Adult leaf. Note the leaf base-*lb*. 11. *C. plumosa*. Terminal leaflet of the primary axis of leaf. 12. *C. urens*. Simple eophyll x *c*.½. 13. *C. urens*. A bifid eophyll x *c*. ½. 14. *C. urens*. Arrangement of flowers on a secondary axis of inflorescence showing ♂ and ♀ flowers x *c*. ½. 15. *C. urens*. Secondary axis of inflorescence showing crowded fruits. 16. *C. urens*. A stoma on the lower epidermis x *c*. 340 : Note the cuticular bands-*cb* on the guard cells. 17. *C. mitis*. A stoma on the lower epidermis x *c*. 340 : Note wavy walls of cells and cuticular bands on the guard cells. 18-23 Fruits in *C. maxima*, *C. rumphiana*, *C. obtusa*, *C. urens*, *C. cumingii*, *C. plumosa* x *c*.½. 24-25. *C. mitis* x *c*. ½. 26. *C. urens* L. S. of a fruit showing seed—*sd*, ruminations—*rn* and lateral position of embryo—*em* x *c*. 3. 27-28. *C. urens*. Seeds : Note the corrugated surface in 27 and lobed structure in 28. 29. *C. plumosa*. Seed x *c*. 4. 30. *C. mitis*. Seed x *c*. 4 : Note the ruminations.

Male flowers have two scaly rudimentary bracts and 3 sepals with ciliated margin (Text-fig. 42). Petals 3, reddish and conical. Stamens 17. Anthers as long as the petals, basifixed. Female flowers develop after the male flowers. They have 3 filamentous staminodes as in *C. urens* (Text-fig. 49). The fruit is a one-seeded drupe 0·5 cm. in diameter. The seed coat is much corrugated.

Ectocarp layer of the fruit is limited by a row of sclereides. The mesocarp is similar to that in *C. urens.* Endocarp is single-layered, unlike the many-layered endocarp of *Hyphaene, Cocos,* etc. The ruminations extend to the interior of the endosperm. They have thick lamellae full of hemicellulose. The embryo is conical and lateral. The seeds do not readily germinate. New plants are easily obtained from suckers as in *C. sobolifera.* The eophyll is simple and has convergent venation.

Habitat. Burma, from Arakan southwards, Martaban. Malay peninsula, Penang. Andaman Islands. Often cultivated in gardens in India.

6. **Caryota plumosa** Hort.

(Plate I, fig. 3)

The tree attains a height of 7 m. Its plumose leaves are highly characteristic. The feathery nature of leaves is due to close insertion of very thin pinnae on the rachis, opposite to each other. The stem is distinctly annulate and woody.

The crown of leaves has about 20 bipinnate leaves, each measuring 1 m. There are 2-18 secondary axes on each leaf, 5 pairs in the apical part, 4 in the middle and 8 in the basal. At each node there are two pinnae, one small and the other large, 5·0×1·0 cm. and 10·0×2·6 cm. respectively.

The terminal leaflet of the primary axis of the leaf, 20×8·5 cm., is tapering. The side pinnae are 11×5 cm.

The inflorescence has a few pendulous spikes, 20-30 per fruiting axis. The arrangement of flowers is similar to that in *C. mitis.* There are 17 stamens in a male flower. The fruit is one-seeded drupe, seed coat wrinkled and endosperm filled almost completely by ruminations. This character of the seed of this species is so distinct and different, that it forms a diagnostic feature of this species.

The percentage of germination of seeds in this species is very low. New plants arise mostly by suckers. The first eophyll is simple, multicostate and convergent.

Habitat. This species is originally from Brazil and has been introduced in India and Ceylon. It grows well in Peradeniya Gardens, Ceylon.

7. **Caryota cumingii** Lood.

The single-stemmed tree reaches a height of 13·5 m. The spathes and peduncles are massive. The rings on the tree trunk are very deep and resemble steps. The fruit is a drupe, 1·4 cm. in length. Seeds take about a year to germinate.

Habitat. A native of Philippine Islands. Sometimes introduced in gardens elsewhere, e.g., in the Fairchild Tropical Garden, Florida, U.S.A. It is the rarest species grown in India.

GENERAL CONSIDERATIONS

A. *Morphological*

(1) Stem: The stem in palms though generally single and soboliferous, shows several types. Van Mohl (1845) has proposed a classification of palms on the basis of stem characters: (a) *Geonoma*-like, (b) *Calamus*-like, (c) *Mauritea*-like, (d) *Cocos*-like and (e) the so-called stemless palms like *Nipa.* A considerable amount of food material accumulates in the trunk and it takes different shapes.

The stem of *Caryota* is *Cocos*-like. It is cylindrical, woody and distinctly annulate, the number of annuli varying from 15-25, and internodes from 13-45 cm. The young stem is covered with woolly tomentum in *C. plumosa* and *C. mitis.*

The growth habit of *Caryota* stem is of two kinds: single and soboliferous as in *C. urens*, and clumpy with several reedy stems as in *C. mitis.* In *C. sobolifera* one or two shoots arise from the main soboliferous trunk near its base, but not many as in *C. mitis.* One can easily recognise different species with the help of stem characters: —

I. Plants growing singly, stem annulate, internodes long, surface of the tree trunk rough and with vertical cracks :

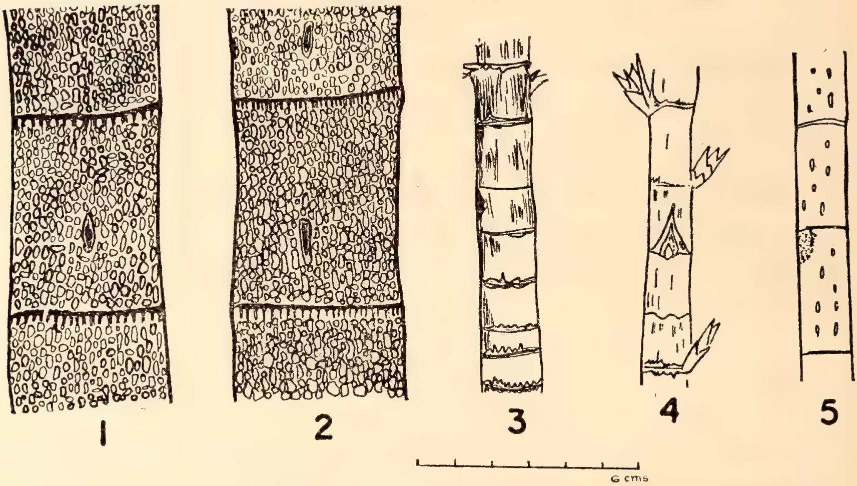
Trees 12 m. high, the length of an internode 40 cm. . . . . *C. urens* (Text-fig. 1).
Tree 24 m. high, internodes more than 40 cm. long, bark very hard. . . . . *C. rumphiana* (Text-fig. 2).
Trees 13·4 m. high, with deep nodal depressions. . . . . *C. cumingii.*

II. Plants growing in clumps, internodes small, bark smooth but clothed with woolly tomentum when young. Scars of fallen leaf-bases and peduncles at nodes prominent :

Trees 7 m. high, internodes 18 cm. long, nodes very conspicuous, bark woody .... *C. plumosa* (Text-fig. 5).

Trees 10-11 m. high, stem soboliferous with one or two basal shoots, internodes 25 cm. long.............................*C. sobolifera* (Text-fig. 3).

Trees 6-7 m. high, length of an internode 13 cm., stem clothed with woolly tomentum when young........................*C. mitis* (Text-fig. 4).



Figs. 1-5. Stem in *Caryota*

Fig. 1. *C. urens* ; Fig. 2. *C. rumphiana* ; Fig. 3. *C. sobolifera*; Fig. 4. *C. mitis*; Fig. 5. *C. plumosa*

(2) Roots and Rooting Region: The basal portion of the tree trunk a little above and below the ground gives rise to many adventitious roots, which cover one or two nodes above the ground. They are relatively few and thick, often not fully developed, swollen and twisted. They dry up and die and are not absorbing. In *C. rumphiana* and *C. urens* they occupy 2-4 annuli above the ground and 2-3 below it. Those below the ground growing laterally function as stilt roots. The other underground ones are extensive and form a bowl-shaped root-bearing base from which the roots radiate in all directions over a long distance. For example, in *C. rumphiana* they extend to 8 m. from base.

(3) Leaf: The leaf in *Caryota* is quite different from that in other palms because (i) of its bipinnate nature, (ii) induplicate vernation of leaflets, (iii) absence of mid-vein, (iv) swollen pulvini at the base of the leaflets on the secondary axes, (v) fan-shaped lamina with multicostate divergent veins, and (vi) the presence of odd

terminal leaflet at the apex of the primary and secondary rachises. The odd terminal leaflet forms a diagnostic character of species. It has two side pinnae just below the terminal leaflet and two small triangular associated pinnae in some species e.g. in *C. urens*, *C. sobolifera* and *C. mitis*. The associated pinnae are just below the side pinnae in *C. urens* and *C. mitis* or in between the terminal pinnae and the side pinnae in *C. sobolifera*.

The leafbase is long, ligulate and more or less tubular. In related palms such as *Areca* it is not tubular. The leaf sheath splits ventrally and is connected to the main trunk by persistent fibres highly resistant to decay.

It may be noted here that multicostate divergent venation of leaflets as in *Caryota* is also found in other members of the Caryotoideae such as *Wallichia*, *Arenga* and *Didymosperma* and in some *Cocoineae* like *Martinezia*. But the leaflets of *Martinezia* have a distinct midrib which is wanting in *Caryota*. Induplicate vernation also is seen in tribes Coryphoideae, Phoenicoideae, Borassoideae, but in Coryphoideae the pinnae have no midrib.

All these leaf characters are useful in identification of species (see Table p. 472):—

I. Terminal leaflet of the primary rachis with a deep incision :

Terminal leaflet with a pair of side pinnae and two associated pinnae below the side pinnae.................................*C. urens* (Text-fig. 6).

Terminal leaflet 17×7 cm., with a deep incision, four associated pinnae lying between the terminal and side pinnae..*C. sobolifera* (Plate II, fig. 9 and Text-fig. 10).

Terminal leaflet 13×12 cm., associated pinnae two, side pinnae with central projection.....................*C. mitis* (Plate II, fig. 10 and Text-fig. 9).

II. Terminal leaflet of the primary rachis without a deep incision :

Terminal leaflet thick and leathery, 35·6×10 cm., associated pinnae absent, side pinnae present below the terminal leaflet....*C. rumphiana* (Text-fig. 7).

Terminal leaflet thin and papery, without a deep incision, 17×7 cm., side pinnae generally one, and without any associated pinnae..*C. plumosa* (Plate II, fig. 11 and Text-fig. 8).

(4) Stomata: The stomata in the Caryotoideae have a unique character namely, teeth on the guard cells, which forms an important character of the Caryotoid palms. However, it has been reported in *Bactris* not belonging to Caryotoid palms (Tomlinson 1961), and in *Equisetum* unrelated to palms.

Epidermal cells of the leaf are either smooth as in *C. urens*, *C. rumphiana* (Plate II, fig. 16; Text-fig. 22), or wavy as in *C. mitis*

TABLE

MORPHOLOGY OF STEM, LEAF, STOMATA, INFLORESCENCE, FLOWERS, FRUIT AND SEED IN *Caryota*

	C. urens 1	*C. rumphiana* 2	*C. plumosa* 3	*C. sobolifera* 4	*C. mitis* 5
STEM	Single 12-19 m. with 15-20 annuli	Single 24-38 m. with 20 annuli	In clumps 7 m. with less than 15 annuli	Generally 2, 10.5 m. with less than 15 annuli	More than 5, each 7 m. with less than 20 annuli
LEAVES :	3·9-4·5 m. long.	5·1-6·0 m.	1·0-1·5 m.	2·1-2·4 m.	0·9-1·2 m.
Pinnae	30×4 cm.	35×4 cm.	10×2·5 cm.	16×4 cm.	17×5 cm.
Texture	Leathery with waxy coating	Very leathery	Very thin	Not thick	Very thin
Terminal leaflet of the primary rachis	22×8 cm., bifid, with a long central projection	35·0×10·0 cm., bifid	17·0×7 cm., incision deep	18×14 cm., incision deep	13·0×12·0 cm., incision deep
Associated pinnae-length and breadth	15×5 cm.	32×5 cm.	24×3·5 cm.	18×6 cm.	17×5 cm.
Number of secondary axes on the primary petiole or rachis	18-25	20-25	10-20	14-25	12-18
Number of pinnae per secondary axis	14	14	4	4-6	4
Terminal leaflet of the secondary axis	23×40 cm., with one end pointed	20×7 cm., with end not pointed	12×3 cm., with end not pointed	17×8 cm., with end not tapering	20×8.5 cm., with one end tapering

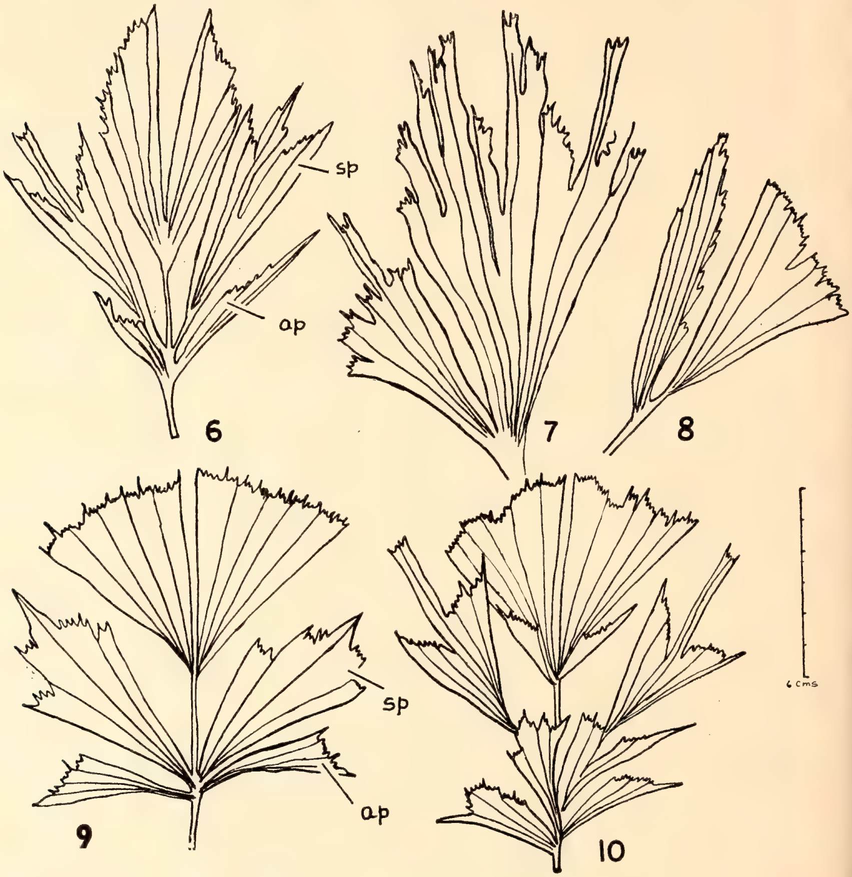
	1	2	3	4	5
Associated side pinnae	17×2·5 cm.	18×7 cm.	15×3 cm.	13×3 cm.	11×5 cm.
EPIDERMIS AND STOMATA :					
Epidermal cells	Straight-walled	Straight-walled	Wavy-walled, hairs present on lower epidermis	Wavy-walled	Wavy-walled, epidermal hairs on lower surface
Stomata on the guard cells	40×20 μ, with 14-16 cuticular bands	51×21 μ, with 16-18 cuticular bands	22×13 μ, with 14-16 cuticular bands	15×8 μ, with 14-16 cuticular bands	22×13 μ, with 8-9 cuticular bands
INFLORESCENCE :	300-360 cm., spikes 40 per spadix	360-420 cm., spikes 40-46	40 cm., spikes 25-30	37 cm., spikes 35	30 cm., spikes 30
A spike on secondary axis	150 cm., long	150 cm.	30 cm.	30 cm.	30 cm.
FLOWERS :					
Stigma in ♀ flowers	Sessile, 2-3-fid, ovules 2 anatropous	Sessile, 2-3-fid, ovules 2 anatropous	Sessile, 2-3-fid, ovules 2 anatropous	Sessile, 2-fid, ovule 1, hemi-anatropous	Sessile 1, ovule 1, hemi-anatropous
Staminodes in ♂ flowers	0	0	1-3	0	0
Pollen grains	24·0×13·2 μ	21·6×6·4 μ	13·2×11·6 μ	13·6×11·6 μ	13·1×11·5 μ
FRUIT :					
Diameter	1·4 cm.	1·6 cm.	—	0·7 cm.	0·5 cm.
SEEDS:	2, 1·2 cm. in diameter	2, 1·4 cm. in diameter	—	1, 0·4 cm. in diameter	1, 0·5 cm. in diameter

TABLE

MORPHOLOGY OF STEM, LEAF, STOMATA, INFLORESCENCE, FLOWERS, FRUIT AND SEED IN *Caryota*

	C. urens 1	*C. rumphiana* 2	*C. plumosa* 3	*C. sobolifera* 4	*C. mitis* 5
STEM	Single 12-19 m. with 15-20 annuli	Single 24-38 m. with 20 annuli	In clumps 7 m. with less than 15 annuli	Generally 2, 10.5 m. with less than 15 annuli	More than 5, each 7 m. with less than 20 annuli
LEAVES:	3·9-4·5 m. long.	5·1-6·0 m.	1·0-1·5 m.	2·1-2·4 m.	0·9-1·2 m.
Pinnae	30×4 cm.	35×4 cm.	10×2·5 cm.	16×4 cm.	17×5 cm.
Texture	Leathery with waxy coating	Very leathery	Very thin	Not thick	Very thin
Terminal leaflet of the primary rachis	22×8 cm., bifid, with a long central projection	35·0×10·0 cm., bifid	17·0×7 cm., incision deep	18×14 cm., incision deep	13·0×12·0 cm., incision deep
Associated pinnae-length and breadth	15×5 cm.	32×5 cm.	24×3·5 cm.	18×6 cm.	17×5 cm.
Number of secondary axes on the primary petiole or rachis	18-25	20-25	10-20	14-25	12-18
Number of pinnae per secondary axis	14	14	4	4-6	4
Terminal leaflet of the secondary axis	23×40 cm., with one end pointed	20×7 cm., with end not pointed	12×3 cm., with end not pointed	17×8 cm., with end not tapering	20×8.5 cm., with one end tapering
Associated side pinnae	17×2·5 cm.	18×7 cm.	15×3 cm.	13×3 cm.	11×5 cm.
EPIDERMIS AND STOMATA:					
Epidermal cells	Straight-walled	Straight-walled	Wavy-walled, hairs present on lower epidermis	Wavy-walled	Wavy-walled, epidermal hairs on lower surface
Stomata on the guard cells	40×20 μ, with 14-16 cuticular bands	51×21 μ, with 16-18 cuticular bands	22×13 μ, with 14-16 cuticular bands	15×8 μ, with 14-16 cuticular bands	22×13 μ, with 8-9 cuticular bands
INFLORESCENCE:	300-360 cm., spikes 40 per spadix	360-420 cm., spikes 40-46	40 cm., spikes 25-30	37 cm., spikes 35	30 cm., spikes 30
A spike on secondary axis	150 cm., long	150 cm.	30 cm.	30 cm.	30 cm.
FLOWERS:					
Stigma in ♀ flowers	Sessile, 2-3-fid, ovules 2 anatropous	Sessile, 2-3-fid, ovules 2 anatropous	Sessile, 2-3-fid, ovules 2 anatropous	Sessile, 2-fid, ovule 1, hemi-anatropous	Sessile 1, ovule 1, hemi-anatropous
Staminodes in ♂ flowers	0	0	1-3	0	0
Pollen grains	24·0×13·2 μ	21·6×6·4 μ	13·2×11·6 μ	13·6×11·6 μ	13·1×11·5 μ
FRUIT:					
Diameter	1·4 cm.	1·6 cm.	—	0·7 cm.	0·5 cm.
SEEDS:	2, 1·2 cm. in diameter	2, 1·4 cm. in diameter	—	1, 0·4 cm. in diameter	1, 0·5 cm. in diameter

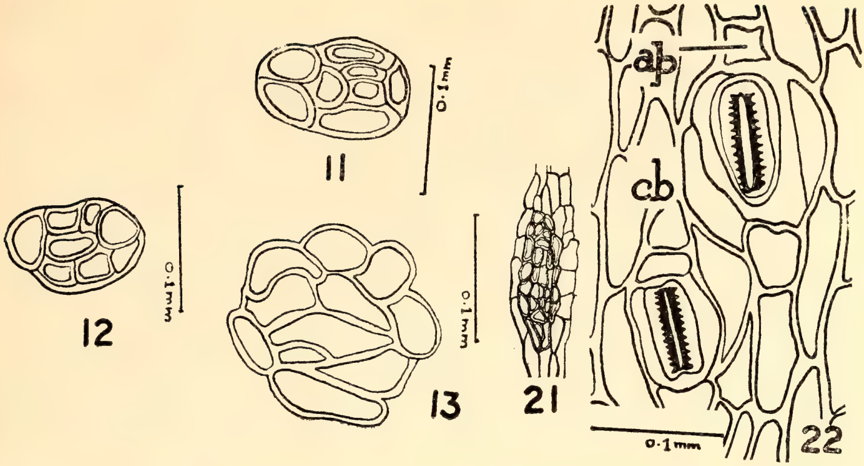
(Plate II, fig. 17). The distribution of stomata is more on the lower epidermis than on the upper. Persistent multicellular bases of hairs are seen on the lower epidermis of leaf in *C. mitis* and *C. plumosa.* Similar hair bases are present in the intercostal region of the leaves in *Wallichia disticha* and *Arenga saccharifera* (Text-figs. 13, 11).



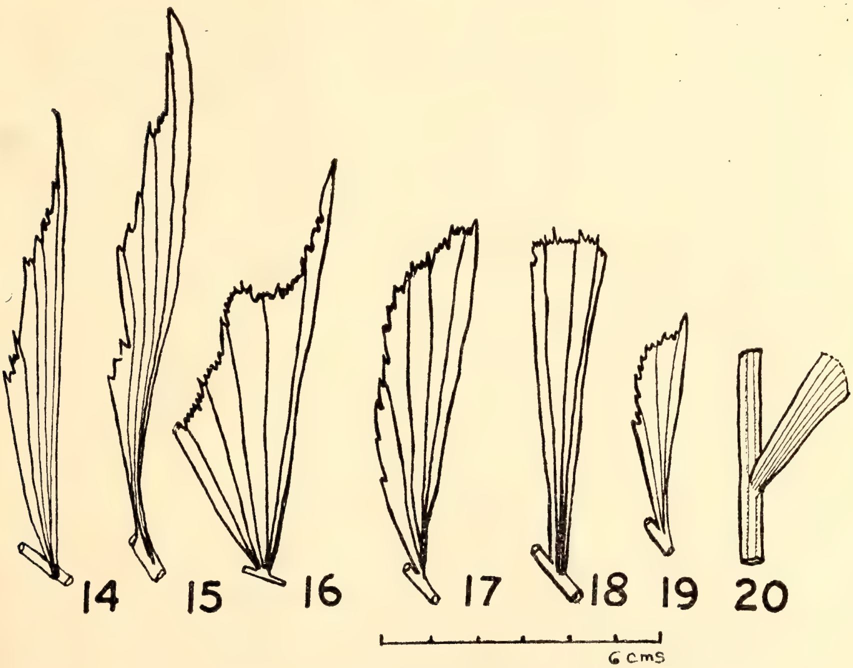
Figs. 6-10. Terminal leaflets

Fig. 6. *C. urens*; Fig. 7. *C. rumphiana*; Fig. 8. *C. plumosa*; Fig. 9. *C. mitis*; Note the side pinnae—*sp*, and the associated pinnae—*ap*. Fig. 10. *C. sobolifera*

(5) Leaf form: These are shown in Plate II, figs. 9-13. Brown (1956) reported some leaves of palms from the Middle and Upper Triassic of Colorado under the name *Sanmiguelia*. This is an important discovery though controversial, as it extended the ancestry of angiosperms far too back. Angiosperms are generally believed to have arisen mainly in the Cretaceous period. Assuming *Sanmiguelia* to be a palm and not an outsized *Ginkgo* or *Cordaites*, or a large *Schizoneura* as has been thought, it certainly helps us


0·1mm
11
0·1mm
12
0·1mm
13
21
ab
cb
0·1mm
22

Figs. 11-13 & 21. Bases of hairs on the lower epidermis in *Arenga saccharifera*, *C. plumosa*, *Wallichia disticha*, and *C. mitis* respectively. Fig. 22. *C. rumphiana*. Stoma on the lower epidermis. Note the cuticular bands on the guard cells *cb*, the apical cells (pole cells)—*ap*.


14
15
16
17
18
19
20
6 cms

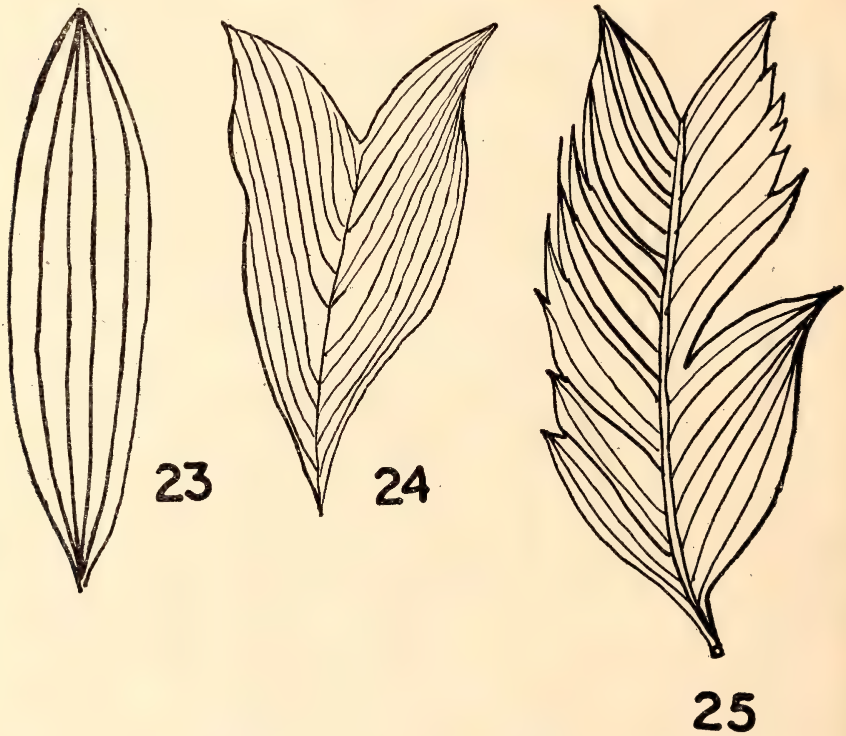
Figs. 14-20. Pinna

Fig. 14. *C. urens*; Fig. 15. *C. rumphiana*; Fig. 16. *C. mitis*; Fig. 17. *C. sobolifera*; Figs. 18, 19. *C. plumosa*; Fig. 20. *C. plumosa*. Attachment of pinna

in tracing the origin of the pinnate versus palmate habit of leaves in palms, as the leaves in *Caryota* are intermediate in form, and have multicostate convergent or divergent veins as in *Sanmiguelia.*

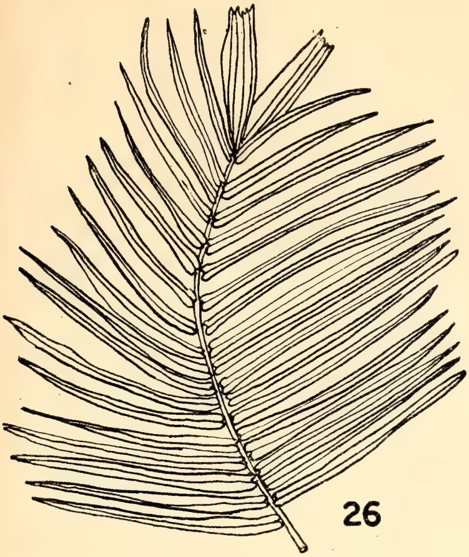
The leaves in *Caryota* are bipinnate, a condition so rarely found in palms. The pinnae are cuneate, multicostate and divergent, neither pinnate as in *Cocos* or *Phoenix*, nor palmate as in *Borassus.* The question, therefore, arises as to how these two dominant forms of leaves in palms have arisen?

Ontogeny of leaf in palm throws some light on this question. Both these dominant types of leaves can be derived from a common source such as multicostate simple leaf in young *Caryota.* Eophylls in *Cocos nucifera, Hyphaene indica, Phoenix acaulis, Livistona chinensis,* and the transitional leaf forms in other palms have entire lamina with multicostate convergent venation (Tomlinson 1960 a).



Figs. 23-25. *Cocos nucifera.* Seedling leaves

In palmately cut leaves of *Livistona* also the eophylls are entire, but they get split later at the apex repeatedly above the ligule, so that veins seem to arise from a single ligule on the petiole. Thus the initially convergent veins of an eophyll become divergent, the



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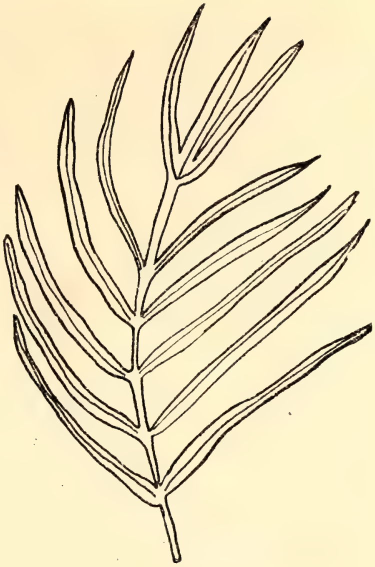

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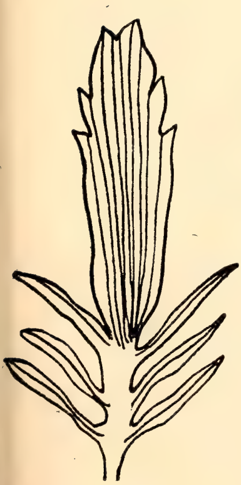
Fig. 26. *Cocos nucifera.* An adult leaf (diagrammatic)
Fig. 27. *Phoenix acaulis.* An adult leaf (diagrammatic)



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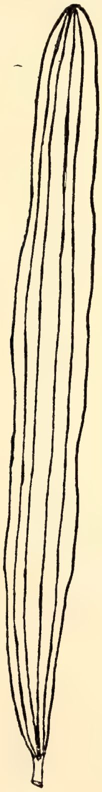

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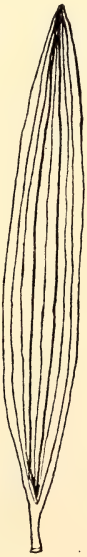

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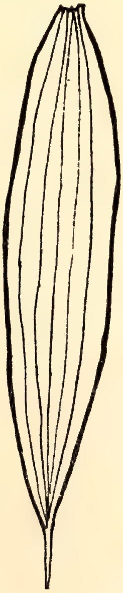

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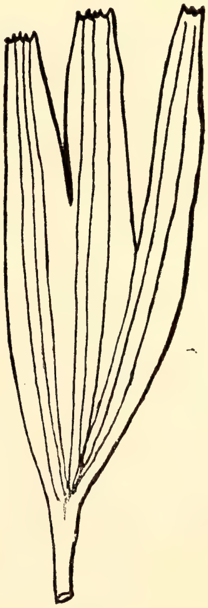

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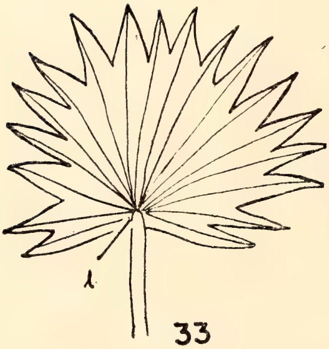
Figs. 28, 30. *Phoenix acaulis.* Early eophylls. Fig. 29. *Hyphaene indica.* Eophyll
Fig. 31. *Livistona chinensis.* An eophyll. Fig. 32. *L. chinensis.* A trifid eophyll

veins being inserted on the ligule divergently and not one above the other as in the pinnatisect leaves (*cf.* Text-figs. 28, 30, 31 & 32).

In pinnate type of leaf as in *Phoenix*, the first eophyll is simple with convergent veins but the basal pinnae get separated first, the pinnae above unfolding acropetally and not simultaneously.

The early eophylls in *Caryota* are entire, multicostate and convergent (Plate II, fig. 12). As the pinnation starts, the eophyll becomes bifid. With further pinnation of the first order, divergence of the costa increases and a fan-shaped leaf is formed. After a couple of pinnae are formed, secondary rachises arise on the primary rachis of leaf and pairs of pinnae begin to appear on the secondary rachises. Ultimately a bipinnate leaf results, with a terminal odd leaflet. In adult leaf young pinnae on secondary rachises are held together by thin reins before unfolding. The splitting of the pinnae starts as in palmate palms and the reins hang down from the margin as in several palms (Eames 1953).

At maturity each pinna in *Caryota* shows multicostate divergent venation like that in an adult leaf of a palmate palm, but the arrangement of pinnae and the entire leaf are more like those in a pinnate leaf. It, therefore, seems to represent an intermediate type of leaf between the two well known patterns of palm leaves, both of which can be derived from a common simple multicostate, ribbed convergent leaf like the eophylls of *Caryota*.



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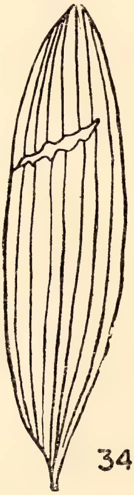

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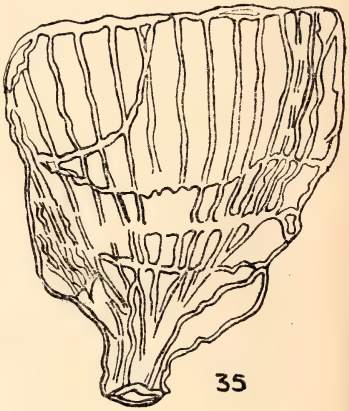

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Fig. 33. *Livistona chinensis*. An adult palmate leaf (diagrammatic). Note the ligule—l at which the cut pinnae remain united without getting separated from each other; Fig. 34. *Sanmiguelia lewisi*. A simple leaf showing convergent costa (after Brown 1956); Fig. 35. *Sanmiguelia lewisi*. A multicostate-leaf (possibly, divergent) (after Brown 1956)

The leaf in *Sanmiguelia*, if it be a real palm, which we believe it is, assumes greater significance in this context, as it shows how *Caryota* leaves could have been derived. *Sanmiguelia* has simple, multicostate, convergent or divergent leaf as in *Caryota*. Its shape is similar to that in the eophylls of palms, which later on gives rise to pinnate or palmate leaves (see diagram p. 480). Should this be really so, the shape of adult leaf in *Caryota* seems to represent a very ancient type of palm leaf, similar to that in *Sanmiguelia*, and suggests that palm leaf may have been evolved as shown below:—

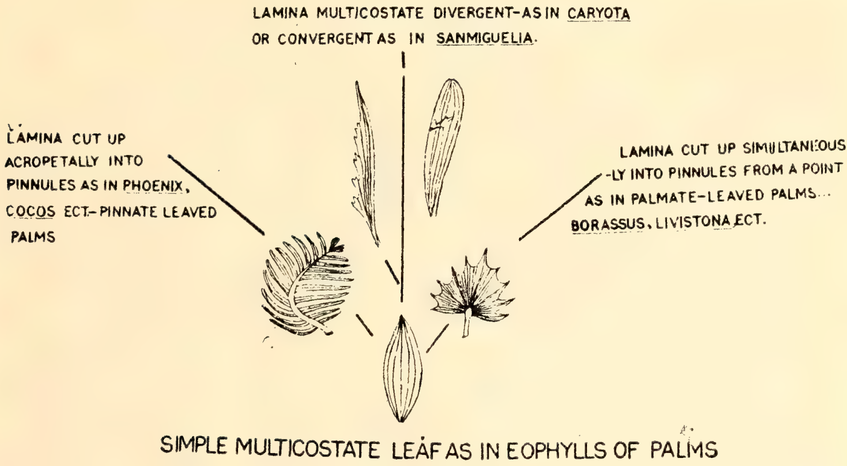

LAMINA MULTICOSTATE DIVERGENT-AS IN CARYOTA
OR CONVERGENT AS IN SANMIGUELIA.
LAMINA CUT UP ACROPETALLY INTO PINNULES AS IN PHOENIX, COCOS ECT-PINNATE LEAVED PALMS
LAMINA CUT UP SIMULTANEOUS-LY INTO PINNULES FROM A POINT AS IN PALMATE-LEAVED PALMS... BORASSUS, LIVISTONA ECT.
SIMPLE MULTICOSTATE LEAF AS IN EOPHYLLS OF PALMS

Diagram illustrating the phylogeny of palm leaves

(6) Inflorescence and flowers: (Plate II, figs. 7, 8, 14; Text-figs. 39-54)

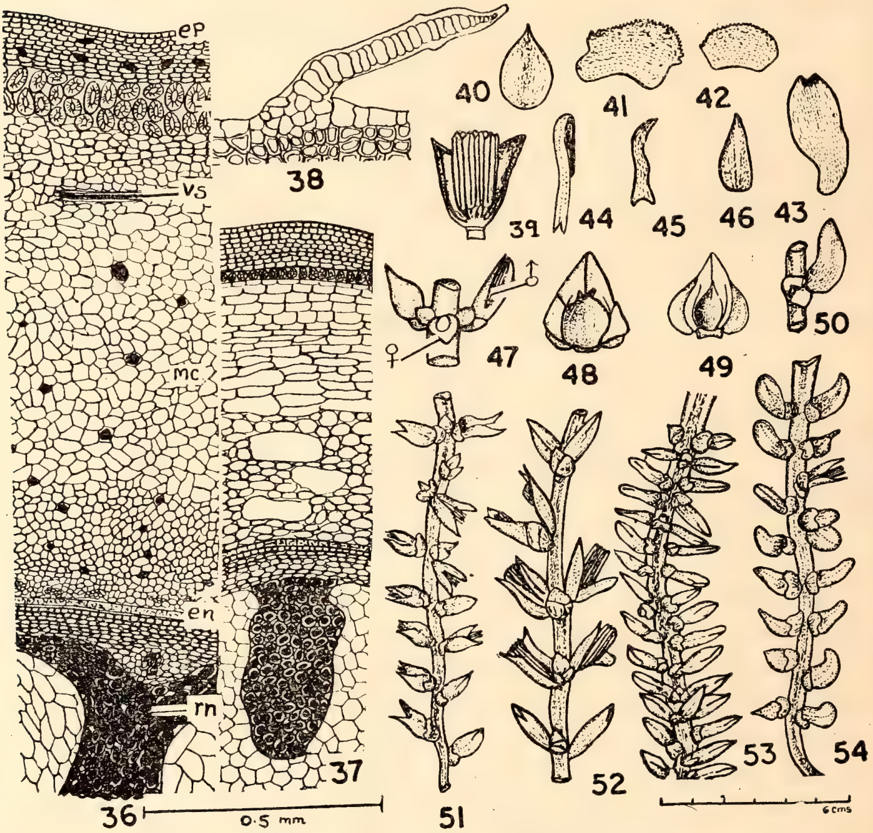
The inflorescences in *Caryota* are highly characteristic because they arise basipetally. In extreme cases as in *C. mitis* they arise even at the ground level and then the plant dies. But new suckers propagate the species vegetatively.

The flowers in *Caryota* are unisexual. In male flowers in *C. sobolifera*, there are 1-3 large staminodes. A few hermaphrodite flowers are also seen in this species. The number of stamens forms a distinguishing character for specific identification. In the female flower the ovary is subtrigonal, mono- or bicarpellary. The stigma is sessile and bi- or trifid. Three filamentous staminodes are present in female flowers, but there are no pistillodes in male flowers (Text-figs. 43-46 and 48, 49).

(7) Fruit and Seeds: (Plate II, figs. 15, 18-30; Text-figs. 36-38, 55-60)

The fruit in *Caryota* is 1-2 seeded drupe, two-seeded in *C. urens* and *C. sobolifera* and one-seeded in *C. mitis* and *C. plumosa*. The largest fruit is that of *C. maxima* which is 1·4 cm. in diameter as against 1·2 cm. of *C. urens* or 0·4 cm. in *C. mitis*.

The seed in *Caryota* is endospermous and highly wrinkled outside with grooves and furrows. The endosperm is ruminated and forms another diagnostic feature of the genus. The extent of rumination



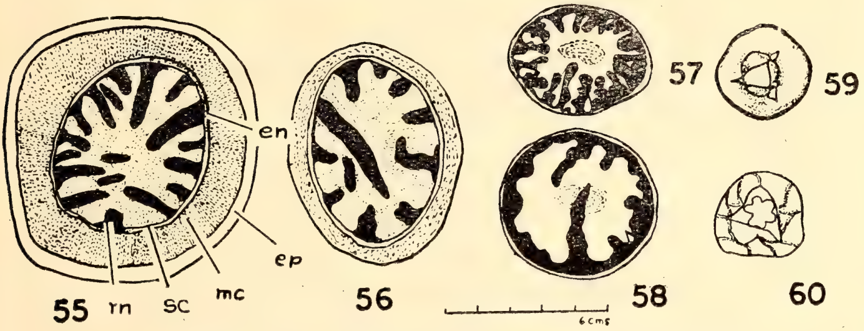
Figs. 36-54. Inflorescence, flower, fruit and seeds in *Caryota*

Figs. 36, 37. *C. urens*, *C. mitis*, T.S. of fruit showing epicarp—*ep*, mesocarp—*mc*, vascular trace—*vs*, endocarp—*en*, ruminations—*rn*, Fig. 38. *C. urens*. A seed hair. Fig. 39. *C. urens*. Male Flower. Fig. 40. *C. urens*. Sepal of a male flower. Fig. 41. *C. urens*. A sepal of a female flower showing frilled edge. Fig. 42. *C. mitis*. Sepal of a male flower. Figs. 43, 44, 45, 46. *C. sobolifera*. Staminodes in a male flower. Fig. 47. *C. urens*. Arrangement of flowers showing one female between two male flowers. Figs. 48, 49. *C. urens* and *C. mitis*. A female flower showing ovary and filamentous staminodes. Fig. 50. *C. sobolifera*. One male and one female flower side by side. Fig. 51. *C. mitis*. Fig. 52. *C. rumphiana*. Fig. 53. *C. urens*. Fig. 54. *C. sobolifera*. Secondary axis of inflorescence differs in different species. In *C. plumosa* the ruminations are many, extending up to the central part of the seed, but in *C. urens* they are not so extensive.

The seed coat is multi-layered. In germination multicellular hairs develop on its surface. Other details regarding the seed are given in the Table (pp. 472-73). The endosperm cells are 159×36 μ in *C. urens*, 226×80 μ in *C. rumphiana*, 80×25 μ in *C. mitis* and 75×22 μ in *C. plumosa*.

(8) Germination: (Text-figs. 61-75)

The seeds of *C. urens* and *C. rumphiana* germinate in about 100 days in well prepared soil. *C. cumingii* takes about 317 days. Stray references to the germination of *Caryota* seeds have been made by Gatin (1912) and Saakov (1954) in *C. urens* and *C. sobolifera*. As no detailed account of it, however, was available, it is given below in *C. urens* and *C. rumphiana*.

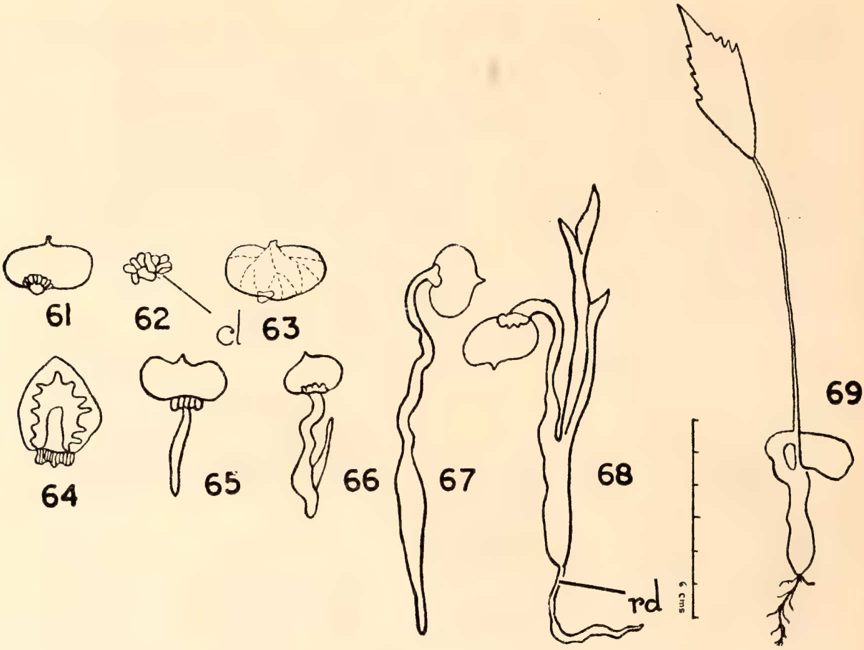


Figs. 55-60. Fruits and seeds of *Caryota*

Fig. 55. *C. urens*. Fig. 56. *C. mitis*. T. S. of fruit-*ep*, epicarp : *mc*, mesocarp ; *en*-endocarp ; sc-seed coat ; rn-ruminations. Fig. 57. *C. urens* : T. S. of seed showing ruminations and endosperm-*en* (diagrammatic). Fig. 58. *C. mitis* : T. S. of seed (diagrammatic). Fig. 59. *C. urens*. Fruit. Fig. 60. *C. maxima*. Fruit

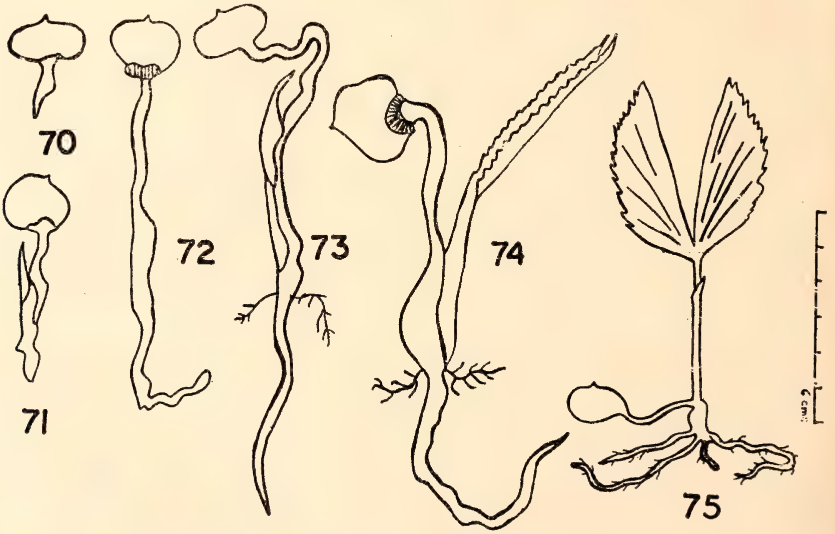
The first plumular leaf appears as a sheathing scaly leaf in *C. urens* and *C. rumphiana*. In both the species, a small protuberance is formed early, through which a cotyledonary tube comes out and forms a frilled collar-like structure around it (Text-figs. 61-62). Its function seems to be absorption. The tube so formed grows vertically downwards and gets swollen in the middle. The swelling enlarges and the plumular initial emerges from it. The radicle goes down and the adventitious roots come out.

The plumular sheath gets split and eophylls begin to unfold. Scaly sheathing leaves appear next. A single simple eophyll emerges and gets split into a bilobed structure. The single eophyll stage is of



Figs. 61-69. Germination of seeds in *Caryota*

Figs. 61-64. *C. urens*. Early stages in germination. Note the Collar-cl in Fig. 62. Fig. 65. A cotyledonary tube emerging through the Collar. Fig. 66-69. Further stages in germination. Note the swelling of the tube in 67, the emergence of plumular initials in 66 and sheathing leaves and the radicle—*rd* in Fig. 68. Fig. 69. A seed ling with simple eophyll



Figs. 70-75. Germination of seeds in *Caryota*

Figs. 70-74. *C. rumphiana*. Germination of seed. (Note the typical remotive type of germination in Fig. 73). Fig. 75. *C. mitis*. A bifid seedling (after Tomlinson 1960) very short duration and easily escapes attention. When the seedling establishes itself firmly, the seed gets detached from the region of the collar. Early stages of germination in *C. urens* and *C. rumphiana* are similar (*cf.* Text-figs. 61-64, 70-74). According to Saakov (1954) germination in palms is of two types: (1) the *Admotive* type in which the middle piece of coleorrhiza or the germ-tube is very small or absent as in *Cocos* and (2) *Remotive* type in which the middle piece of germ-tube is very long as in *Phoenix* or *Caryota* described here. In most palms, germination is of the *Remotive* type.

B. *Habitat and Distribution*

The genus *Caryota* appears to be of Indo-Malayan origin. Four species are native to India. Besides India, other centres of distribution are Andamans and Nicobar Islands, Indonesia and Philippines (Map). The genus is conspicuously absent in the New World. The number of valid species of *Caryota* is about a dozen according to Blatter (1926) and 13 according to Moore (1960 a).

The Map shows the distribution of palms, and of all the valid species of *Caryota.* They lie within 20° N. and 20° S. *C. urens* has by far the widest geographical distribution. *C. rumphiana* is confined to India and northern Australia and *C. mitis* mainly to Andamans. The remaining species are confined to Malaysia and Philippines where many of them are concentrated.

C. *Past History of the Genus*

Most of the present day species seem to be of recent origin. The only authentic record of it in the past is by Reid & Chandler (1933) who found its seeds in the London Clay Flora, belonging to the Tertiary period. They have described these under the name *Caryotispermum cantiense* which had three seeds, 0·9 cm. in diameter, instead of two as in *C. urens*, or one as in *C. mitis.* Apparently this Tertiary species was three-seeded, though in point of size and shape of its seeds, it agrees with those in *C. urens.* The genus thus seem to have undergone evolutionary changes as shown below:—

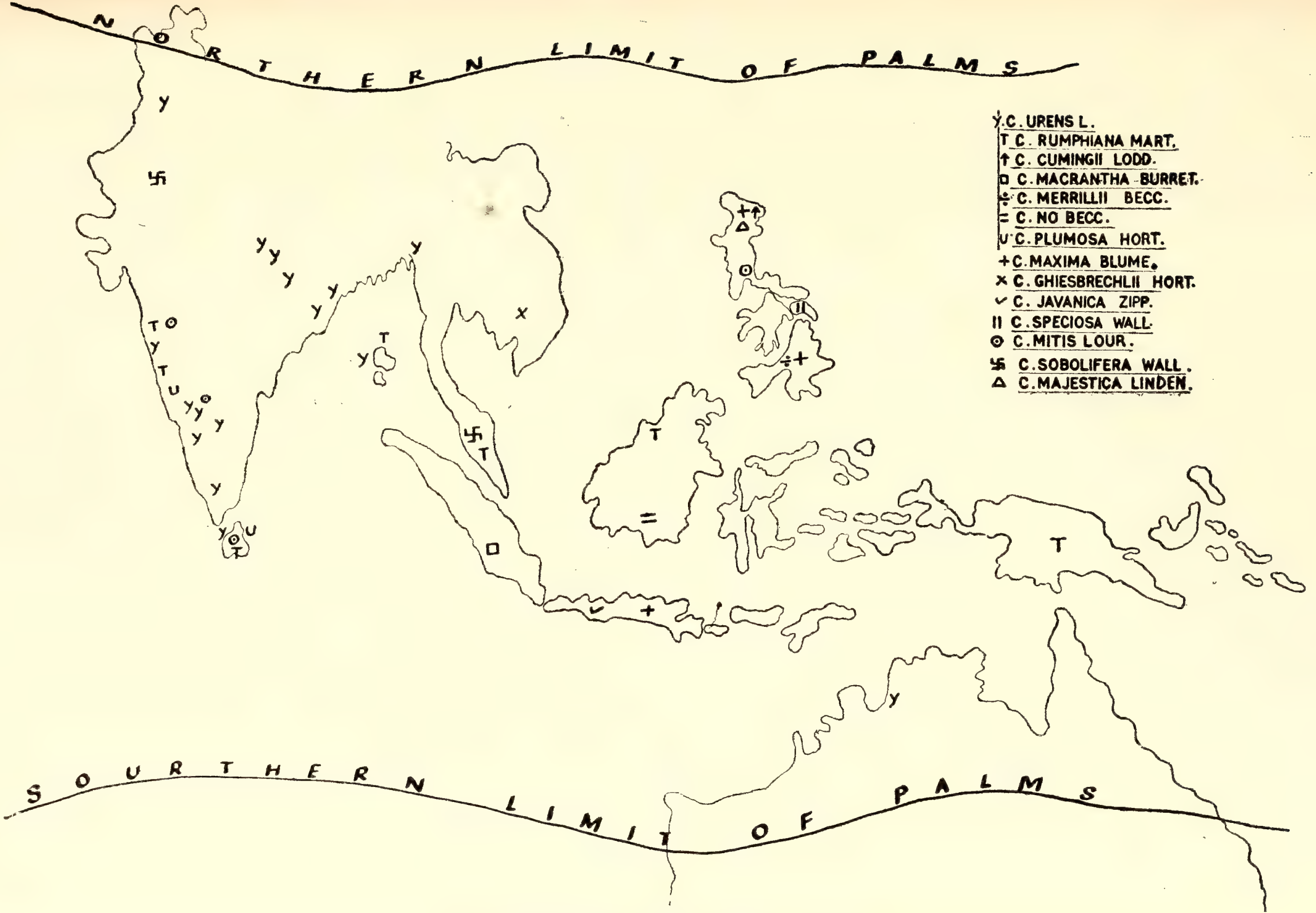
3-seeded Tertiary species—*Caryotispermum cantiense.*
2-seeded living species—*C. urens, C. maxima.*
1-seeded living species—*C. mitis.*

D. *Systematic Position of the Caryotoideae*

Systematic position of the Caryotoid palms, *Caryota, Wallichia, Arenga,* and *Didymosperma* has been controversial. Martius (1850) had included this group as 'Caryotinae' in the subfamily Arecineae. Bentham & Hooker (1883) had put it as a subtribe 'Caryotideae' in the subfamily Areceae, but had included the genera *Orania* and *Sclerosperma* also in this subtribe. Drude (1887) considered that the Caryoteae forms a tribe of the subfamily Ceroxylineae. He also included the genus *Orania* in the Caryoteae. Blatter (1926) following Drude's classification put it under the tribe Ceroxylineae under the subtribe Arecineae. Pichi-Serimolli (1956) in a posthumous paper with Beccari placed this group under the subfamily Arecoideae, but excluded the genus *Orania* from it. Moore (1960) who revised the classification of Palmae has put it in the section 'A' of the Palmae in which the leaf vernation is induplicate or 'V'-shaped in T. S., as against Section 'B' in which it is reduplicate. He seems justified in doing this as in the genus *Caryota*, the leaf though it lacks midrib has induplicate vernation of pinnae. Tomlinson (1960 b) has kept them separate as a subfamily of the Palmae excluding *Orania*. Moore's (1960 a) raising this group therefore, to the status of a subfamily, Caryotoideae, separating it from the Arecoid palms seems more logical, equivalent in status to that of the subfamily Arecoideae. According to Moore (1960 a) striking differences between the Caryotoid and other palms are in (1) the manner of flowering from top to bottom in a basipetal sequence, (2) several inflorescences at a node growing centripetally, the inner ones developing first, (3) the pistillate flowers with valvate petals united below the middle or above, a feature that is seen only in *Roystonea* among the Arecoid palms, (4) pinnae without midrib and with divergent veins ending in teeth, (5) eophylls simple and convergent, (6) presence of cuticular teeth on the guard cells.

To this Sharma & Sarkar (1956: *Genetica* **28**: 361-488) have added one more point. According to them the shape and size of chromosomes in the Caryotoid palms is different from that of the Arecoid palms. They are, therefore, probably ancestral to the latter. According to Moore (1960 a) however, they are a highly specialised group which deviated quite early from a pro-Arecoid stock. With this our findings broadly agree.

Caryotoid palms also show superficial resemblance with other palms such as *Borassus* or *Phoenix* in which the pinnae have induplicate vernation. Some of their characters, such as aggregate inflorescences at a node, trilocular ovary, urent mesocarp, several bracts on the inflorescences, are also found in species of *Arenga* and


NORTHERN LIMIT OF PALMS
Y C. URENS L.
T C. RUMPHIANA MART.
↑ C. CUMINGII LODD.
□ C. MACRANTHA BURRET.
÷ C. MERRILLII BECC.
= C. NO BECC.
U C. PLUMOSA HORT.
+ C. MAXIMA BLUME.
× C. GHIESBRECHLII HORT.
✓ C. JAVANICA ZIPP.
II C. SPECIOSA WALL.
⊙ C. MITIS LOUR.
卐 C. SOBOLIFERA WALL.
△ C. MAJESTICA LINDEN.
SOURTHERN LIMIT OF PALMS

The Distribution of the Genus *Caryota*

in the genus *Chamaedorea* of the New World and its allies. But the bi- or monocarpic habit and structure of both staminate and pistillate flowers in *Caryota* are quite unlike those in *Chamaedorea*. However the basic arrangement of flowers in Caryotoid palms in triads is similar to that in the advanced members of the Arecoideae like *Ptychosperma*. The pollen tube in *Caryota* is short and sterility percentage high as in Arecoid palms.

Moore (1960a) further suggests that within the Caryotoideae, *Arenga* appears to be the most primitive genus, because of its simple imparipinnate or undivided leaves, male and female inflorescences often aggregated, distinct sepals and petals in staminate flowers, numerous stamens, trilocular ovary with 2-3 fertile locules, and homogeneous endosperm.

Caryota is more advanced than *Arenga* as it has bipinnate leaves (although its juvenile foliage is imparipinnate). Its solitary inflorescences, reduction of fertile locules to 1 or 2, pistillate flowers with less united petals than those of *Arenga* and ruminated endosperm support such a conclusion.

Wallichia is still more advanced than *Caryota* as the staminate and pistillate inflorescences in it are separate. There is union of perianth parts in the staminate flowers, and the number of stamens is reduced to 6 in some of its species.

However, in the light of the present investigation the genus *Caryota* does not seem to occupy an intermediate position. For example, it has hermaphrodite flowers in *C. sobolifera*, 3 staminodes in male flowers, bipinnate leaf and ruminated endosperm. These characters rather suggest that the genus *Caryota* is more advanced than *Wallichia* and *Arenga*. We, therefore, think that the evolutionary sequence of these genera could be *Arenga*, *Didymosperma*, *Wallichia* and *Caryota*.

In the genus *Caryota* itself, *C. urens* seems to represent the central stock, and *C. mitis* its extremely specialized form within the genus, species having been evolved by decrease in the number of stamens and fertile loculi, and by increase in the number of clumpy stems.

SUMMARY

The paper gives an account of the taxonomy of the genus *Caryota* in India. It describes four wild and three cultivated species. Significant features of the genus *Caryota* are bipinnately compound leaf with multicostate divergent venation of the pinnae, their induplicate

vernation and stomata with cuticular bands on the guard cells. Basipetal arrangement of the inflorescences, ruminated endosperm and *Remotive* type of germination are other diagnostic features useful in the taxonomy of its species. Systematic position of the Caryotoideae has been discussed and it broadly supports Moore's view (1960a). Moore (1960) removes Caryotoid palms from the Arecineae or Ceroxylineae and puts them into a separate subfamily 'Caryotoideae' equivalent to the subfamily Arecineae. Within Caryotoid palms the genus *Caryota* seems to occupy the highest position.

Past history of the genus *Caryota* has been traced which suggests that the present day two-seeded or one-seeded species like *C. urens* or *C. mitis* have been evolved from a three-seeded Tertiary species like *Caryotispermum cantiense* Reid & Chandler (1933) found in the London Clay Flora.

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A Supplementary list of the Host-Plants of lac Insects

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INTRODUCTION

Lac insects, specially of the Genus *Laccifer*[3] because of their great economic importance, have attracted naturalists from time to time to collect information about their host-plants, both by field surveys or experiment and from scattered literature. Attempts in this direction were first made in 1901 by Sir George Watt, who listed 56 such plants. Roonwal *et al.* (1958) listed 14 common, 14 occasional, and 85 rare (total 113) host-plants of the lac insect, *Laccifer lacca* (Kerr) and its closest allies in the Indian Region, comprising India, Pakistan, and Burma. Roonwal & Singh (1958) added a ' supplementary list ' by listing 79 more names of host-plants, without going through their present nomenclative position.

Since then, many workers including those of the Entomology Division, Indian Lac Research Institute, Ranchi, have reported a number of new lac host-plants. A thorough review of the literature on lac and lac insects has also revealed several lac-hosts occurring all over the world. The junior author during his visit to Thailand in July 1963, also collected information on lac-hosts in that country through the courtesy of the Royal Forest Department and Department of Agriculture, Thailand. The present list gives an account of all such host-plants together with names which have not been mentioned by Roonwal *et al.* (1958) and Roonwal & Singh (1958).

As the identity of some species of lac insects is still doubtful, the names of the lac insect species have been mentioned in the accompanying list as per source. Nomenclature of the host-plants, their author's name and family, though mostly based on original description, have been brought up-to-date by consulting INDEX KEWENSIS and its supplements, WEALTH OF INDIA, SIAMESE PLANT NAMES, Willis's DICTIONARY OF FLOWERING PLANTS AND FERNS, Bailey's MANUAL OF CULTIVATED PLANTS, and Raizada (1958). Some plant names, whose scientific position could not be determined from these references, were sent for verification to the Royal Botanic Gardens, Kew, Surrey. The report sent by the Director has been given in full, with the lac-hosts concerned, in the list. The classification of the host-plants in different categories according to their importance in lac cultivation forms a subject matter for further study. The present list is intended to assemble in one place the much scattered information about the lac-hosts already recorded in different parts of the world, for ready reference by research workers engaged in the task of selecting potentially useful lac-hosts for their regions.

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[3] A recent study (*Indian J. Ent.* **28**: 116-118. 1966) by the senior author of this work has revealed that the generic name, *Laccifer* Oken, 1815, is invalid and should be substituted by generic name *Kerria* Targ., 1884. The International Commission on Zoological Nomenclature has looked into the case and confirmed this change.

ALPHABETICALLY ARRANGED LIST OF LAC-HOSTS

The available information in respect of each host-plant has been presented in the following order :

Serial No. ; scientific name of the plant and author of the plant species as given originally ; present nomenclative position of the host-plant if it has changed ; family or natural order of plant; synonyms of the plant ; notes on availability of lac ; species of the lac insect and country where it has been observed ; sources of the information with year and page number of the references.

Sharapov & Prokopenko (1960) have given a list of host-plants under the title ' List of plants growing lac insects, distributed in India, Burma, Ceylon, China and Thailand.' For convenience these countries have been substituted by ' Oriental region ' in the present list.

1. **Acacia** sp. (Leguminosae). *Laccifer lacca* (Kerr) feeds on sap (Bhasin & Roonwal 1954, p. 27).

2. **A. cavenia** Bertol. ex Bull. (Leguminosae). Host-plant of *Laccifer mysorensis* in India (Kapur 1958, p. 22).

3. **A. chundra** (Roxb.) Willd. (Leguminosae). Syn. *A. sundra* DC. *Laccifer lacca* and *L. mysorensis* have been observed on this plant in Indian region (Kapur 1958, pp. 20 & 22).

4. **A. confusa** Merrill (Leguminosae). Food plant of the lac insect in Siam and Formosa (Takahashi 1949, p. 25).

5. **A. dealbata** Link (Leguminosae). *Laccifer lacca* and *L. sindica* are reported on it from the Oriental region and Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, pp. 18 & 30).

6. A. **decurrens** Willd. (Leguminosae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).

7. A. **donaldii** Haines (Leguminosae). Regional host tried for lac cultivation at Damoh, India (I.L.R.I. Ann. Rep. for 1962-63, p. 17).

8. A. **intsia** Willd. (=*A. caesia* Willd.) (Leguminosae). Possible important host for lac utilization in south Madras and wherever gregarious in India (Negi 1956, p. 47). Lac is commonly seen on it at Travancore, India (Barker 1921).

9. A. **rugata** Buch.-Ham. (Leguminosae). Host-plant of *L. lacca* (Kapur 1958, p. 20, mentioned it as synonym of *A. concinna* DC.).

10. A. **torta** (Roxb.) Craib (Leguminosae). Unsatisfactory host of lac (Thakur 1932, p. 3). Host-plant of *L. communis* reported from India (Kapur 1958, p. 16).

11. **Acer laevigatum** Wall. (Aceraceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

12. **Ailanthus fauveliana** Pierre (Simaroubaceae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).

13. **Albizzia** sp. (Leguminosae). Food plant of the lac insect in Formosa. On the stem of a young tree at Taihoku, Formosa, mortality of the lac insect larvae was more on the lower part than on the upper part (Takahashi 1949, pp. 23, 31). *L. lacca* (Kerr) and *L. albizziae* (Green) feed on its sap (Bhasin & Roonwal 1954, pp. 54-55).

14. A. **julibrissin** Durazz. (Leguminosae). Lac-host in Georgia, U.S.S.R. Experiments of lac culture are also running on this plant in Russia, since 1958 (Sharapov & Prokopenko 1960, p. 30 and Fig. 22).

15. A. **kalkora** (Roxb.) Prain (Leguminosae). *L. lacca* and *L. sindica* are reported on it from the Oriental region (Sharapov & Prokopenko 1960, p. 18).

16. A. **marginata** Buch.-Ham. (Leguminosae). Host-plant of *L. lacca* (Kapur 1958, p. 20 mentioned it as synonym of *A. stipulata* Boivin).

17. **A. richardiana** King & Prain (Leguminosae). Good encrustation of *Rangeeni* strain of *L. lacca* was observed on this plant at Calcutta, India, during 1961-62 (Srivastava, Rao & Varshney 1964, pp. 104-105). Also in 1962 at Indian Botanic Gardens, Calcutta (Mukhopadhyay 1962, p. 329 ; Bhattacharya & Prasad 1964, pp. 702-703).

18. **Aleurites fordii** Hemsl. (Euphorbiaceae). Classified as bad host of lac on the basis of its pH value range (Thakur 1932, p. 3).

19. **A. triloba** Forst. (Euphorbiaceae). Syn. *A. moluccana* Willd. Lac-host recorded from Punjab, India (Watt 1901, p. 210 ; Roonwal & Singh 1958, p. 134 ; Malhotra 1964, p. 368, synonymy given).

20. **Amherstia nobilis** Wall. (Leguminosae). Host of *T. albizziae* in Ceylon (Green 1922, p. 413 ; Chamberlin 1923, p. 166 ; Bhasin & Roonwal 1954, p. 65 ; Sharapov & Prokopenko 1960, p. 18 ; Gupta 1962, p. 114). Also of *L. communis* in India (Kapur 1958, p. 14). It carried excellent *Rangeeni* strain of *L. lacca* at Calcutta, India (Mukhopadhyay 1962, p. 329 ; Bhattacharya & Prasad 1964, pp. 702, 703).

21. **Annona cherimolia** Mill. (Annonaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

22. **A. muricata** Linn. (Annonaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16) and of *L. lacca* in Oriental region (Sharapov & Prokopenko 1960, p. 18).

23. **A. palustris** Linn. (Annonaceae). Host of *T. conchiferata* in Ceylon (Green 1922, p. 408 ; Chamberlin 1923, p. 172 ; Gupta 1962, p. 114). Also host of *L. lacca* in Oriental region (Sharapov & Prokopenko 1960, p. 19). Host of *L. communis* in India (Kapur 1958, p. 16).

24. **Aralia cordata** Thunb. (Araliaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

25. **A. vitchii** T. Moore (=*Dizygotheca veitchii* N. Taylor) (Araliaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

26. **Averrhoa carambola** Linn. (Oxalidaceae). Host of *Laccifer* sp. and *L. greeni* in Formosa (Takahashi 1928a, p. 347 ; 1928b, p. 261 ; 1929, pp. 7 & 69).

27. **Bischofia trifoliata** (Roxb.) Hook. (=*Bischofia javanica* Bl.) (Euphorbiaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).

28. **Bombax malabaricum** DC. (=*Bombax ceiba* Linn., (Bombacaceae). A minor lac-host in Punjab, India (Anand 1936, p. 9; Malhotra 1964, pp. 367-368).

29. **Buchanania lanzan** Spreng. (Anacardiaceae). Syn. *B. latifolia* Roxb. Host-plant of *L. lacca* in Oriental region (Sharapov & Prokopenko 1960, p. 19). Lac infection was observed at Taimara, Ranchi Forest Division, India (Purkayastha & Krishnaswami 1961, p. 152 ; Mukhopadhyay 1962, p. 328).

30. **B. lucida** Blume (Anacardiaceae). Host-plant of *L. chinensis* in Thailand (based on information provided to the junior author by the Royal Forest Department, Thailand).

31. **Caesalpinia** sp. (Leguminosae). *L. lacca* feeds on the sap of this host in the Oriental region (Sharapov & Prokopenko 1960, p. 18 ; Bhasin, Roonwal & Singh 1958, p. 51).

32. **C. digyna** Rottl. (Leguminosae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).

33. **C. sappan** Linn. (Leguminosae). Host-plant of *L. communis* reported from India (Kapur 1958, p. 16).

34. **Calliandra haematocephala** Hassk. (Leguminosae). Host of *Laccifer* sp. and *L. greeni* in Formosa (Takahashi 1928a, p. 347 ; 1928b, p. 261 ; 1929, pp. 9 & 69).

35. **Carissa opaca** Stapf. (Apocynaceae). Lac-host recorded exclusively from Punjab, India. (Malhotra 1964, p. 369, synonymy given). However, this is not given as food plant of lac insect by Stebbing (1910), as has been shown by Malhotra (loc. cit.).

36. **Carya olivaeformis** Nutt. (=*C. illinoensis* Koch) (Juglandaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).

37. **Cassia** sp. (Leguminosae). *L. lacca* feeds on its sap (Bhasin, Roonwal & Singh 1958, p. 90).

38. **C. surattensis** Burm. f. (Leguminosae). Syn. *C. glauca* Lam. Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 18).

39. **Castanopsis** sp. (Fagaceae). *Laccifer lacca* observed on it in Indian region (Kapur 1958, p. 20).

40. **Casuarina equisetifolia** Forst. (Casuarinaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16). Host on which lac insect cannot maintain itself due to insufficient bio-chemical factors (Sreenivasaya 1924, pp. 120, 124 & 125). Besides this, Sreenivasaya (1924) has classified two more hosts on which lac insect cannot maintain itself. They are *Dodonaea viscosa* (Linn.) Jacq. (Sapindaceae) and *Lantana camara* Linn. (Verbenaceae).

41. **Catha edulis** Forsk. (Celastraceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

42. **Celtis cinnamomea** Lindl. (Ulmaceae). Syn. *C. roxburghii* Bedd. Lac-host recorded from Punjab, India. [Watt 1901, p. 211 ; Malhotra 1964, p. 369, synonymy given. Bhasin, Roonwal & Singh (1958) and WEALTH OF INDIA treat *C. roxburghii* Planch as synonym of *C. tetrandra* Roxb.].

43. **Charoetengia** sp. Lac grown on it at Assam, India (Stebbing 1910, p. 76). Director, Royal Botanic Gardens, Kew, states that this plant name could not be identified.

44. **Citrus** sp. (Rutaceae). Host of *Laccifer* sp. in Formosa (Takahashi 1928a, p. 347 ; 1929, pp. 11 & 70).

45. **C. maxima** (Burm.) Merrill (Rutaceae). Bugs of *L. lacca* Kerr are pests and suck fruits of this plant (Mathur, Singh & Lal 1958, pp. 28 & 98, mention *C. grandis* Osbeck. and *C. decumana* Linn. as synonyms).

46. **Codiaeum variegatum** Blume (Euphorbiaceae). *L. albizziae* feeds on its sap (Mathur & Singh 1960a, p. 12).

47. **Cola acuminata** Schott et Endl. (Sterculiaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).

48. **Combretum quadrangulare** Kurz. (Combretaceae). Lac-host in Thailand (Samapuddhi 1957, p. 30 ; also according to information provided to junior author by the Royal Forest Department, Thailand). One of the chief lac-hosts of Siam (Gupta 1962, p. 127).

49. **C. quadrangulare** Kurz. var. **lanceolatum** (Combretaceae). Host of *L. chinensis*, reported from India, Indo-China, and Siam (Kapur 1958, p. 15).

50. **Commiphora caudatum** W. & A. (=*Commophora caudata* Engl.) (Burseraceae). Host-plant of *L. communis* in India [Kapur 1958, p. 16, written as ‘ *Commiphora* (*Protium*) *caudatum* W. & A.’].

51. **Connarus paniculatus** Roxb. (Connaraceae). Lac-host in Burma (Gupta 1962, p. 135).

52. **Corylus** sp. (Betulaceae). Prof. E. V. Borkhsenius reported it as host-plant of lac in U.S.S.R., while giving a talk at Indian Lac Research Institute, Ranchi, on 17-2-1964 on ‘ Works carried out on lac insect in the Soviet Union ’.

53. **C. maxima** Mill. (Betulaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).

54. **Croton** sp. (Euphorbiaceae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).

55. **C. argyratus** Blume (Euphorbiaceae). Reported as lac-host from Thailand (Samapuddhi 1957, p. 30).

56. **C. caudatus** Geisel. (Euphorbiaceae). Host of *T. albizziae* in India (Green 1922, p. 413 ; Kapur 1958, p. 14 ; Sharapov & Prokopenko 1960, p. 20 ; Mathur & Singh 1960a, p. 34).

57. **C. lacciferus** Linn. (Euphorbiaceae). Host of *T. conchiferata* and *T. albizziae* in Ceylon (Green 1922, pp. 408 & 413 ; Kapur 1958, p. 14, mentions it as synonym of *C. aromaticus* Linn. ; Sharapov & Prokopenko 1960, p. 20 ; Gupta 1962, p. 114).

58. **Cynometra polyandra** Roxb. (Leguminosae). Excellent *Rangeeni* lac crop was observed on it at Calcutta, India (Mukhopadhyay 1962, p. 329 ; Bhattacharya & Prasad 1964, pp. 702-703).

59. **Daemonorops draco** Blume (Palmaceae). A climbing jungle palm. Dragon’s blood (mistaken for lac) is taken from it in China (Mahdihassan 1954, p. 319). In our view this is a doubtful record of a lac-host.

60. **Dalbergia** sp. (Leguminosae). A creeper and rare lac-host in Burma; common in Shan Plateau and near Inle Lake (Watt 1901, p. 90 ; Norris 1931, pp. 13 & 18). Roonwal *et al.* (1958) have reported many species of *Dalbergia* as lac-host, but have given their habit as moderate-sized to large deciduous trees.

61. **D. arborea** Willd. (Leguminosae). Host of *L. lacca* in the Oriental region [Sharapov & Prokopenko 1960, p. 18, mentioned it as synonym of *Pongamia glabra* Vent. (=*Pongamia pinnata* Pierre)].

62. **D. cochinchinensis** Pierre (Leguminosae). Lac-host in Thailand (Samapuddhi 1957, p. 30 ; also according to information provided to junior author by the Royal Forest Department, Thailand). Host of *L. chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 15).

63. **D. eupeaux** var. **laccifera** Eberhardt & Dubard (Leguminosae). Host-plant of *Coccus lacca* in Indo-China. One of the hosts found by Crevost, and reported as ' Co-Khet ' (Hautefeuille 1924, p. 15). Regarding this plant's name the Director, Royal Botanic Gardens, Kew, writes : ' This name, nor anything like it, traced in *Dalbergia* '.

64. **D. hupeana** Hance (Leguminosae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 18).

65. **D. hupeana** var. **laccifera** Eberhardt & Dubard (Leguminosae). Host of *L. chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 15).

66. **D. kerrii** Craib (Leguminosae). Host of *L. chinensis* reported from India, Indo-China, and Siam (Kapur 1958, p. 15).

67. **D. nigrescens** Kurz. (Leguminosae). Host of *L. chinensis* reported from India, Indo-China, and Thailand (Kapur 1958, p. 15 ; also according to information provided to junior author by the Royal Forest Department, Thailand).

68. **D. szemaoensis** Prain (Leguminosae). Host of lac insect in Yunnan, China. (Chung-lo 1957, p. 86 ; Gupta 1962, p. 120 ; and Roonwal 1962, p. 36). Host of *L. lacca* in Oriental region (Sharapov & Prokopenko 1960, p. 18). Director, Royal Botanic Gardens, Kew, has checked the identity of this plant species.

69. **D. tamarindifolia** Roxb. [=*D. pinnata* (Lour.) Prain] (Leguminosae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 18).

70. **D. yunanensis** Franch. (Leguminosae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 18).

71. **Delonix regia** (Boj.) Raffin. (Leguminosae). Syn. *Poinciana regia* Bojer ex Hook. Host-plant of *L. communis* in India (Kapur 1958, p. 16). Host on which the lac insect maintains itself but does not grow (Sreenivasaya 1924, pp. 120, 124 & 125).

72. **Derris robusta** Benth. (Leguminosae). Lac host in Burma (Gupta 1962, p. 135).

73. **Desmodium** sp. (Leguminosae). Food plant of the lac insect in Siam (Takahashi 1949, p. 23).

74. **D. gyrans** DC. [=*D. motorium* (Houtt.) Merrill] (Leguminosae). Host-plant of *L. mysorensis* in India (Kapur 1958, p. 22).

75. **D. oldhami** Oliver (Leguminosae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 18).

76. **D. purpureum** Fawc. et Rendle. (Leguminosae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960 p. 18).

77. **D. triflorum** (Linn.) DC. (Leguminosae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 18).

78. **Dillenia pentagyna** Roxb. (Dilleniaceae). Lac encrustation was found on it at Taimara, Ranchi Forest Division, India (Purkayastha & Krishnaswami 1961, p. 152; Mukhopadhyay 1962, p. 329).

79. **Diospyros** sp. (Ebenaceae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).

80. **D. kaki** Linn. f. (Ebenaceae). Host of *L. lacca* in the Oriental region and Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, pp. 20 & 30).

81. **D. lotus** Linn. (Ebenaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).

82. **D. melanoxylon** Roxb. (Ebenaceae). Syn. *D. tupru* Buch.-Ham. Host-plant of *L. mysorensis* in India (Kapur 1958, p. 22) and of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20). Small colonies of lac insects with good development were met on '*D. tupra*' at Dursanipalya, India (Mahdihassan 1923, p. 64).

83. **D. tomentosus** Roxb. (=*D. exsculpta* Buch.-Ham.) (Ebenaceae). *Rangeeni* lac was observed to reach maturity on this plant in

both crops of 1962 at Kundri Forest, Bihar, India (Malhotra & Kulkarni 1964, p. 119).

84. **Dipterocarpus** sp. (Dipterocarpaceae). *L. lacca* feeds on its sap (Mathur & Singh 1960b, p. 53).

85. **D. alatus** Roxb. (Dipterocarpaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).

86. **Dolichandrone spathacea** K. Schum. (Bignoniaceae). *L. lacca* has been reported on it in the Indian region (Kapur 1958, p. 19).

87. **Engelhardtia chrysolepis** Hance (Juglandaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).

88. **E. colebrookiana** Lindl. (Juglandaceae). Lac-host of secondary importance in Yunnan, China (Chung-lo 1957, p. 87 ; Gupta 1962, p. 120 ; and Roonwal 1962, p. 37). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).

89. **Eriolaena malvacea** (Leveille) Hand.-Mazz. (Sterculiaceae). Second favoured host of lac insect in Yunnan, China. Importance assumed by this plant species as a lac-host in Yunnan is in striking contrast with the Indian list of host-plants (Chung-lo 1957, p. 87 ; Gupta 1962, p. 120 ; Roonwal 1962, p. 37). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20, mentioned *E. szemaoensis* Hu. as synonym).

90. **E. spectabilis** Planch. (Sterculiaceae). Lac-host in Burma (Gupta 1962, p. 135).

91. **Erythrina variegata** Linn. [var. *orientalis* (Linn.) Merrill : present authors] (Leguminosae). Syn. *E. indica* Lam. Lac-host recorded from Punjab, India (Watt 1901, p. 211 ; Malhotra 1964, p. 369, synonymy given).

92. **Eugenia** sp. (Myrtaceae). Lac insect has been found on this plant, locally called as ‘ Thabyegyi ’, in Burma, in between Kalat and Saitepha Hills (Watt 1901, p. 89).

93. E. **dalbergioides** Duth. (Myrtaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).

94. E. **jambolana** Lam. (=*Syzygium cumini* Skeels) (Myrtaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).

95. E. **jambos** Linn. [=*Syzygium jambos* (Linn.) Alston] (Myrtaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).

96. E. **michelii** Lam. (Myrtaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).

97. **Euphoria longan** Steud. (Sapindaceae). Syns. *E. longana* Lam. and *Nephelium longana* Cambess. Host of *L. greeni* in Formosa (Takahashi 1928b, p. 261 ; 1929, pp. 14 & 69). Food plant of lac insect in Siam (Takahashi 1949, p. 24). Suitable lac-host in Taiwan, Formosa Islands, China (Chung-lo 1957, p. 87 ; Gupta 1962, p. 118 ; Roonwal 1962, p. 37). Sharapov & Prokopenko (1960) record *N. longana* as host of *L. lacca* in the Oriental region.

98. **Excoecaria agallocha** Linn. (Euphorbiaceae). Host of *T. conchiferata* in Ceylon (Green 1922, p. 408 ; Chamberlin 1923, p. 172; Mathur & Singh 1960b, p. 115 ; Gupta 1962, p. 114). Also host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).

99. **Feijoa sellowiana** Berg. (Myrtaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).

100. **Ficus** sp. (Moraceae). Type host of *Laccifer javanus*. Locality—Buitenzorg : Java (Chamberlin 1925, p. 34 ; Takahashi 1949, p. 24 ; and Kapur 1958, p. 18). *L. fici* and *L. lacca* feed on the sap of its twigs, shoots, and branches (Mathur & Singh 1960b, p. 150).

101. F. **albipila** King (Moraceae). Host of *Laccifer chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).

102. F. **alternans** Wall. (Moraceae). Host of *L. lacca* in the Oriental region (Kapur 1955, p. 158 ; Sharapov & Prokopenko 1960, p. 17).

103. F. **drupacea** Thunb. (Moraceae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).

104. F. **erecta** Thunb. (Moraceae). A probable food plant of lac insect in Formosa (Takahashi 1949, p. 70).

105. F. **geniculata** Kurz. (Moraceae). Excellent *Rangeeni* lac crop was found on it at Calcutta, India (Mukhopadhyay, 1962, p. 329 ; Bhattacharya & Prasad 1964, pp. 702-703).

106. **F. gibbosa** Blume (Moraceae). Host-plant of lac insect in Yunnan, China (Chung-lo 1957, p. 86; Gupta 1962, p. 120; and Roonwal 1962, p. 37). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 17).

107. **F. krishnae** C.DC. (Moraceae). Host-plant of *L. communis* in India (Kapur 1958, p. 17). Mahdihassan (1936) artificially inoculated *L. mysorensis* on *F. benghalensis* var. *krishnae* at Bangalore, India (Kapur 1955, p. 160).

108. **F. mysorensis** Heyne ex Roth [=*F. drupacea* Thunb. var *pubescens* (Roth)] (Moraceae). Host of *L. communis* at Mysore, India (Mahdihassan 1923, p. 98; 1948, p. 162; and Kapur 1958, p. 17 as synonym of *F. cotoneaefolia*). Host which promotes the maintenance and growth of the lac insect, but does not induce secretion of appreciable quantities of resin (Sreenivasaya 1924, pp. 120, 124 & 125). Host of *L. lacca* in the Oriental region (Mathur & Singh 1960b, p. 132; Sharapov & Prokopenko 1960, p. 17).

109. **F. pilosa** Reinw. (Moraceae). Host of *Laccifer chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 16).

110. **F. polysyce** Ridl. (Moraceae). *L. javanus* was discovered on this plant in Malaya. Attempts to propagate lac on it were also made (Miller 1933, pp. 1, 15 & 16; Gupta 1962, p. 115).

111. **F. rubiginosa** Desf. (Moraceae). Host of *L. communis* and *L. lacca* in the Oriental region; also lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, pp. 17 & 30).

112. **F. ulmifolia** Lam. (Moraceae). Type host of *T. greeni* and reported from Philippine Islands (Chamberlin 1923, p. 168; Kapur 1958, p. 18).

113. **F. wightiana** Wall. (Moraceae). Host of *Laccifer* spp. in Formosa. *L. greeni* specimens from this plant were compared with the Type Specimen by Dr. Chamberlin (Takahashi 1928a, p. 347; 1928b, p. 261; 1929, pp. 15 & 69; 1949, p. 23). Successfully inoculated with lac insect in Taiwan, China (Chung-lo 1957, p. 87; Gupta 1962, p. 118; and Roonwal 1962, p. 37). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 17, mentioned *F. infectoria* Roxb. and *F. lucescens* Blume as synonyms). *Rangeeni* lac was observed on it at Calcutta, India (Mukhopadhyay 1962, p. 329; Bhattacharya & Prasad 1964, pp. 702-703).

114. **Filicium decipiens** Thw. (Sapindaceae). Host of *T. albizziae* in Ceylon (Green 1922, p. 413; Chamberlin 1923, p. 106; Kapur 1958, p. 14; Mathur & Singh 1960b, p. 151; Sharapov & Prokopenko 1960, p. 18; Gupta 1962, p. 114). Mukhopadhyay (1962) reports that this plant was recorded earlier as lac-host by Macmillan in 1914 and by Benthall in 1946, as quoted in WEALTH OF INDIA, Vol. 4 (F-G), 1956, pp. 40-41.

115. **Gardenia (Gordonia) floribunda** Wall. (Rubiaceae). Host of *L. chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 16).

116. **Glycine javanica** Linn. (Leguminosae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

117. **Gossypium barbadense** Linn. (Malvaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).

118. **G. insulare** Pulle. (Malvaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).

119. **Grevillea robusta** A. Cunn. (Proteaceae). Host which promotes the maintenance and growth of the lac insect but does not induce secretion of appreciable quantities of resin (Sreenivasaya, 1924, pp. 120, 124 & 125). Recent record of *Rangeeni* lac on it at Ranchi, India (Prasad & Mehra 1967).

120. **Grewia acuminata** Juss. (Tiliaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).

121. **G. celtidifolia** Juss. (Tiliaceae). Favoured lac-host species of genus *Grewia* in Yunnan, China (Chung-lo 1957, p. 87; Gupta 1962, p. 120; Roonwal 1962, p. 37). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).

122. **G. disperma** Rottl. (=*G. glabra* Bl.) (Tiliaceae). Host of *L. chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 16, mentioned it as synonym of *G. laevigata* Vahl.). Roonwal & Singh (1958) have listed '*Grewia didyma* or *laevigata*' and Hautefeuille (1924) has mentioned '*G. didgma*'.

123. **Guazuma tomentosa** H.B. & Kunth. (=*G. ulmifolia* Lam.) (Sterculiaceae). Lac insect has been found on it. Parthenogenetic cells were also collected from it. Best tree for pseudo-lac insects. *L. mysorensis* grows well (Mahdihassan 1923, pp. 47, 58, 60 and 66). *Lakshadia communis* is said to thrive sufficiently well on this plant (Chamberlin 1925, p. 38).

124. **Haematoxylon campechianum** Linn. (Leguminosae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

125. **Harpullia arborea** (Blanco) Radlk. (Sapindaceae). Host-plant of *Laccifer albizziae* (Kapur 1958, p. 14).

126. **H. cupanioides** Roxb. (Sapindaceae). Host of *T. albizziae* in Ceylon. Yellow colony was also observed (Green 1922, p. 413 ; Chamberlin 1923, p. 166 ; Mathur & Singh 1960c, p. 36 ; and Gupta 1962, pp. 114-115) ; also of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).

127. **Helianthus annuus** Linn. (Compositae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

128. **Hemicyclia** sp. (=*Drypetes* sp.) (Euphorbiaceae). According to the material received from Kelawawa, Ceylon, this plant is host of *L. albizziae* (Chamberlin 1923, p. 166).

129. **H. sepiaria** Wight & Arn. [=*Drypetes sepiaria* (W. & A.) Pax & Hoffm.] (Euphorbiaceae). Host of *T. albizziae* in Ceylon (Green 1922, p. 413 ; Chamberlin 1923, p. 166 ; Kapur 1958, p. 14 ; Mathur & Singh 1960c, p. 32 ; Gupta 1962, p. 114).

130. **Heritiera littoralis** (Dryand.) (Sterculiaceae). Host of *L. greeni* in Formosa (Takahashi 1928b, p. 261 ; 1929, pp. 17 & 69).

131. **Hevea brasiliensis** (H.B.K.) Muell.-Arg. (Euphorbiaceae). Attempts were made to propagate *L. javanus* and *L. lacca* on it at Malaya (Miller 1933, pp. 4 & 21 ; 1937, pp. 19 & 24 ; Gupta 1962, p. 115).

132. **Hibiscus mutabilis** Linn. (Malvaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).

133. **H. rosa-sinensis** Linn. (Malvaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).

134. **H. syriacus** Linn. (Malvaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 17).

135. **Hovenia dulcis** Thunb. (Rhamnaceae). Host of *L. lacca* in the Oriental region and Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, pp. 18 & 30).

136. **Hymenaea courbaril** Linn. (Leguminosae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

137. **Jacaranda acutifolia** Humb. & Bonpl. (Bignoniaceae). Syn. *J. mimosifolia* D. Don and *J. ovalifolia* R. Br. Host-plant of *L. communis* and *L. lacca* in Indian region (Kapur 1954, pp. 646-647 ; 1958, pp. 16 & 19-20; Roonwal & Singh 1958, p. 138 ; Mathur & Singh 1960c, p. 75).

138. **Juglans regia** Linn. (Juglandaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30). Prof. E. V. Borkhsenius also reported it as host-plant of lac insect in the U.S.S.R., while giving a talk on 17-2-1964 at the Indian Lac Research Institute, Ranchi, on 'Works carried out on lac insect in Soviet Union'.

139. **Juniperus excelsa** Bieb. (Cupressaceae). Host-plant of *Laccifer lacca* in Indian region (Kapur 1958, p. 20, mentioned it as synonym of *J. macropoda* Boiss. which is recorded as host of lac insect also by Roonwal & Singh 1958, p. 138 ; Mathur & Singh 1960c, p. 82).

140. **Justicia carnea** Nichols. (Acanthaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

141. **Kydia** sp. (Malvaceae). *L. lacca* feeds on it in India (Green 1922, p. 410 ; Chamberlin 1923, p. 171, misspelt as '*Kejdia*' ; Mathur & Singh 1960c, p. 87).

142. **Landolphia** sp. (Apocynaceae). Host of *T. albizziae* in Ceylon (Green 1922, p. 413 ; Kapur 1958, p. 14 ; Gupta 1962, p. 114).

143. **L. kirikii** Dyer (Apocynaceae). *L. albizziae* feeds on sap of stems and leaves (Mathur & Singh 1960d, p. 11).

144. **Lawsonia inermis** Linn. (Lythraceae). Syn. *L. alba* Lam. Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).

145. **Leea aspera** Wall. non Edg. (Vitaceae). One of the major lac-hosts of Assam, India (Krishnaswami & Saikia 1959, p. 297 ; Krishnaswami, 1960 p. 14).

146. **Leucaena glauca** (Linn.) Benth. [=*L. leucocephala* (Lam.) de Wit.] (Leguminosae). Syn. *Mimosa glauca* L. One of the two hosts proposed by Oken as host of his genus *Laccifer* (Cockerell 1924, p. 47 ; Chamberlin 1925, p. 33). Host of *L. lacca* in India (Kapur 1958, p. 20).

147. **Limonia acidissima** Linn. [=*Feronia limonia* (Linn.) Swingle] (Rutaceae). Syn. *Feronia elephantum* Correa. Host of *L. chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 16). Lac-host recorded from Punjab, India (Watt 1901, p. 211 ; Roonwal & Singh 1958, p. 136 ; Malhotra 1964, p. 369, synonymy given).

148. **Liquidambar formosana** Hance (Hamamelidaceae). Host of *L. greeni* in Formosa (Takahashi 1929, pp. 18 & 69).

149. **Macaranga megalophylla** Muell. Arg. (Euphorbiaceae). Fairly extensive lac incrustations of *L. javanus* were found and attempts were made to propagate lac on it in Malaya. Its brood was inoculated on other plants (Miller 1933, pp. 5, 15, 18, & 19 ; 1937, pp. 1 & 10 ; Gupta 1962, p. 115).

150. **M. populifolia** Muell. Arg. (Euphorbiaceae). Attempts were made to propagate *L. javanus* on it in Malaya (Miller 1933, p. 18 ; Gupta 1962, p. 115).

151. **Machilus** sp. (=*Persea* sp.) (Lauraceae). Host of *L. greeni* and *Laccifer* sp. in Formosa (Takahashi 1928a, p. 347 ; 1928b, p. 261 ; 1929, pp. 18 & 69).

152. **Madhuca latifolia** (Roxb.) Macb. (=*M. indica* Gmel.) (Sapotaceae). Syn. *Bassia latifolia* (Roxb.). Host of *L. lacca* in the Oriental region. (Sharapov & Prokopenko 1960, p. 20). Major lac-host in the Punjab, India (Anand 1936, p. 9 ; Malhotra 1964, pp. 367-368).

153. **Mallotus cochinchinensis** Lour. (Euphorbiaceae). Attempts were made to propagate *L. javanus* on it in Malaya (Miller 1933, pp. 4, 18, 19, & 21 ; Gupta 1962, p. 115).

154. **Michelia champaca** Linn. (Magnoliaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 17).

155. **Millettia auriculata** Baker ex Brandis (=*M. extensa* Benth. ex Baker) (Leguminosae). Lac encrustation was found on the leaf of this plant at Taimara, Ranchi Forest Division, India (Purkayastha & Krishnaswami 1961, p. 153 ; Mukhopadhyay 1962, p. 329).

156. **Mimosa** sp. (Leguminosae). Host of *T. conchiferata* in Ceylon (Green 1922, p. 408 ; Gupta 1962, p. 114). Also host-plant of *L. chinensis* in Maejo, Chiengmai, in Thailand (based on information provided to junior author by the Department of Agriculture, Thailand).

157. **M. himalayana** Gamble (Leguminosae). Regional host tried for lac cultivation at Mirzapur, India (I.L.R.I. Ann. Rep., 1962-63, p. 18).

158. **Moghania chappar** (Ham. & Bth.) O. Kuntze (Leguminosae). Syn. *Flemingia chappar* Buch.-Ham. Capable of sustaining both *Rangeeni* and *Kusmi* strains of the lac insect (Purkayastha & Prasad 1962, pp. 541-542 ; Mukhopadhyay 1962, p. 329).

159. **Morus alba** Linn. (Moraceae). Lac insect is reported on it in the Oriental region and in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, pp. 17 & 30).

160. **M. macassariensis** ? (Moraceae). Lac has been reared on it at District Rangpur, India (Buchanan-Hamilton 1825, p. 50 ; Watt 1901, p. 218). Director, Royal Botanic Gardens, Kew, states about the plant species : ' This epithet not traced in *Morus*. There is, however, an *Ampalis madagascariensis* Boj. (Syn. *Morus nitida* Willem.) (family Moraceae), which might have been meant '.

161. **M. nigra** Linn. (Moraceae). Lac insect is reported on it in the Oriental region and from Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, pp. 17 & 30).

162. **Nephelium lappaceum** Linn. (Sapindaceae). Food plant of the lac insect in Siam and Formosa (Takahashi 1949, p. 25).

163. **Ougeinia oojeinensis** (Roxb.) Hochreut (Leguminosae). This is the changed name for *Dalbergia oojeinensis* Roxb. and *O. dalbergioides* Benth. (Raizada 1958, p. 501 ; Prasad 1965, p. 298) and is a successful host of lac insect in India (Roonwal *et al.* 1958, pp. 27, & 76-77 ; Mathur & Singh 1960d, p. 140).

164. **Palaquium formosanum** Hayata (Sapotaceae). Host of *L. greeni* in Formosa (Takahashi 1928b, p. 261 ; 1929, pp. 22 & 69).

165. **Paliurus ramosissimus** Poir. (Rhamnaceae). Food plant of the lac insect in Siam and Formosa (Takahashi 1949, pp. 24 & 26).

166. **P. spina-christi** Mill. (Rhamnaceae). Lac-host in Georgia, U.S.S.R. Experiments of lac culture are running since 1959 on this plant in Russia (Sharapov & Prokopenko 1960, p. 30).

167. **Parkia biglandulosa** W. & A. (Leguminosae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

168. **Peltophorum inerme** (Roxb.) Naves [=*P. pterocarpum* (DC.) Backer ex K. Heyne] (Leguminosae). Syn. *P. ferrugineum* Benth. Host-plant of *L. communis* in India (Kapur 1958, pp. 16-17). Host-plant of *L. lacca* (Kapur 1954, p. 646 ; Mathur & Singh 1960e, p. 10 ; Srivastava, Rao, & Varshney 1964, p. 104).

169. **Pentace burmanica** Kurz. (Tiliaceae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).

170. **Persea gratissima** Gaertn. (Lauraceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

171. **Phyllanthus emblica** Linn. (=*Emblica officinalis* Gaertn.). (Euphorbiaceae). Syn. *Ph. mairei* Levielle. Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).

172. **Pithecellobium** sp. (Leguminosae). *L. lacca* feeds on sap of twigs, branches, and stem (Mathur & Singh 1960e, p. 41).

173. **Platanus orientalis** Linn. (Platanaceae). Host of *L. greeni* in Formosa (Takahashi 1929, pp. 23 & 70).

174. **Polymnia grandis** Hort. (Compositae). Host-plant of *L. communis* in India (Kapur 1958, p. 16, mentioned it as synonym of *Montanoa bipinnatifida* C. Koch).

175. **Premna tomentosa** Willd. (Verbenaceae). Tree observed with lac in India (De 1933, p. 293 ; Tschirch & Stock 1936, p. 1451, Fig. 435).

176. **Prosopis juliflora** DC. (Leguminosae). Host of Sind lac insect, *L. sindica*, in W. Pakistan ; a Brazilian plant (Mahdihassan 1957, p. 114).

177. **Pterocarpus draco** Linn. (Leguminosae). Chinese drug (mistaken for lac) is furnished by it. (Mahdihassan 1954, p. 319). We think it is a doubtful record of lac-host.

178. **P. indicus** Willd. (Leguminosae). Host-plant of *L. communis* in India (Kapur 1958, p. 17).

179. **Pterogaria** ? sp. (Juglandaceae ?). Host-plant of *Coccus lacca* in Indo-China, reported by Crevost as ‘Co-Xom’ (Hautefeuille 1924, p. 15). Director, Royal Botanic Gardens, Kew, informs that it is probably *Pterocarya* Kunth (family Juglandaceae).

180. **Pterospermum acerifolium** Willd. (Sterculiaceae). *L. albizziae* feeds on sap of twigs, branches, and stems (Mathur & Singh 1960e, p. 83).

181. **P. diversifolium** Blume (Sterculiaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).

182. **Putranjiva roxburghii** Wall. (Euphorbiaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16). *L. lacca* feeds on it (Mathur & Singh 1960e, p. 86). Also reported as host of *L. chinensis* by the Royal Forest Department, Thailand to junior author.

183. **Pyrus malus** Linn. (Rosaceae). Host on which it is reported that lac insect continues for three generations (Sreenivasaya 1924, pp. 120, 124, & 125).

184. **Quisqualis** sp. (Combretaceae). Type host of *Laccifer rangoonensis*, reported from Burma (Chamberlin 1925, p. 35 ; Kapur 1958, p. 23).

185. **Rhamnus alaternus** Linn. (Rhamnaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).

186. **Rhodomyrtus tomentosa** Wight (Myrtaceae). Host of *L. greeni* in Formosa. (Takahashi 1929, pp. 24 & 70).

187. **Rhynchosia cana** DC. (Leguminosae). Three inches encrustation was observed on this herb-like plant (Mahdihassan 1923, p. 64). Host-plant of *L. mysorensis* in India (Kapur 1958, p. 22).

188. **R. rufescens** DC. (Leguminosae). Host-plant of *L. mysorensis* reported from India (Kapur 1958, p. 22).

189. **Robinia pseudoacacia** Linn. (Leguminosae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).

190. **Salix** sp. (Salicaceae). The senior author at Indian Lac Research Institute, Ranchi, inoculated it with lac insects, *Katki* 1965 life-cycle. Fine settlement of larvae and early development were observed. This is the first record of rearing lac insect on it or on any member of the Salicaceae.

191. **Schleichera** sp. (Sapindaceae). *L. lacca* (Kerr) feeds on sap of twigs, branches, and stems (Mathur & Singh 1961a, p. 31).

192. **Semecarpus anacardium** Linn. f. (Anacardiaceae). Lac infection was observed on this plant at Taimara, Ranchi Forest Division,

India (Purkayastha & Krishnaswami 1961, p. 152; Mukhopadhyay 1962, p. 328).

193. **Shorea** sp. (Dipterocarpaceae). *L. lacca* (Kerr) feeds on sap of twigs, branches, and stems (Mathur & Singh 1961a, p. 54).

194. **S. cochinchinensis** Pierre (Dipterocarpaceae). Host of *L. chinensis* and *L. lacca* in the Oriental region (Kapur 1958, p. 15 ; Sharapov & Prokopenko 1960, p. 19, respectively).

195. **Spatholobus roxburghii** Benth. (Leguminosae). Lac-host in Burma [Gupta 1962, p. 135, written as '*Spatholobus* (*Butea*) *roxburghii* (*Butea superba*) or (creeper *palas*)', burmese name of plant mentioned as 'Pauk-nwe']. Roonwal *et al.* (1958) reported it as synonym of *Butea parviflora* Roxb., a rare lac-host at Travancore, India. Director, Royal Botanic Gardens, Kew, provides the following nomenclative position : '*Spatholobus roxburghii* Benth. (Syns. *Butea parviflora* Roxb. and *B. sericophylla* Wall.)—family Leguminosae'.

196. **Sterculia pexa** Pierre (Sterculiaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).

197. **Tamarindus** sp. (Leguminosae). *L. lacca* feeds on it (Mathur & Singh 1961b, p. 5).

198. **Tanarius major** ? (=*Macaranga* sp.) (Euphorbiaceae). Lakka wood of China. Source of the red dye-stuff, namely stick-lac (Mahdihassan 1954, p. 321). Present authors think it a doubtful record of a lac-host. Regarding this plant's name Director, Royal Botanic Gardens, Kew, states : 'This epithet not traced in *Tanarius*, or *Macaranga*, under which *Tanarius* is included. (family Euphorbiaceae)'.

199. **Terminalia** sp. (Combretaceae). Food-plant of the lac insect in Siam and Formosa (Takahashi 1949, p. 24).

200. **T. catappa** Linn. (Combretaceae). Host of *L. greeni* in Formosa (Takahashi 1930, p.41).

201. **Theobroma cacao** Linn. (Sterculiaceae). Host of *T. albizziae* in Ceylon etc. (Green 1922, p. 413 ; Kapur 1958, p. 14 ; Mathur & Singh 1961b, p. 48 ; Sharapov & Prokopenko 1960, p. 20 ; Gupta 1962, p. 114).

202. **Tilia** sp. (Tiliaceae). Prof. E. V. Borkhsenius reported it as host-plant of lac in U.S.S.R., while giving a talk on 17-2-1964 at the Indian Lac Research Institute, Ranchi, on 'Works carried out on lac insect in the Soviet Union'.

203. **T. caucasica** Rupr. (Tiliaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).

204. **T. tomentosa** Moench. (Tiliaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).

205. **Varinga latifolia** ? (Moraceae). Lac has been reared on it in District Rangpur, India : plant colloquially known as 'Dhop' (Buchanan-Hamilton 1825, p.50 ; Watt 1901, p. 218, suspects it as a species of *Ficus*, probably *F. cunia*). Regarding the name of this plant, Director, Royal Botanic Gardens, Kew, states : '*Varinga* had only one species published in it—*V. repens* Raf. This is a synonym of *Ficus pumila* L. (family Moraceae). There is, however, a *Vangueria latifolia* Sond. (family Rubiaceae) which might have been meant.'

206. **Vatica chinensis** Linn. (= *Shorea roxburghii* G. Don. (Dipterocarpaceae). Lac insect feeds on it in south India (Buchanan-Hamilton 1800, p. 238 ; Watt 1901, p. 265).

207. **Vitis vinifera** Linn. (Vitaceae). Host of *Laccifer communis* in India (Mahdihassan 1936 ; Kapur 1958, p. 16). Also of *Laccifer lacca*, found at Ranchi, India (Mehra 1955, p. 264 ; Mukhopadhyay 1962, p. 328).

208. **Wrightia tinctoria** R. Br. (Apocynaceae). Host of *L. communis* in India (Kapur 1958, p. 16).

209. **Xylia** sp. (Leguminosae). *L. lacca* feeds on sap of twigs and branches (Mathur & Singh 1961b, p. 99).

210. **X. kerrii** Craib & Hutch. (Leguminosae). Lac-host in Thailand (Samapuddhi 1957, p. 30). Host of *L. chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 15).

211. **Zizyphus** sp. (Rhamnaceae). *L. lacca* feeds on sap of twigs and branches (Mathur & Singh 1961b, p. 111).

212. **Z. lotus** Lam. (Rhamnaceae). Lac and gum of this plant are alike to Arabs (Mahdihassan 1954, p. 322, cited Abu Mansur). In our view it is doubtful whether this plant is a lac-host.

213. **Zizyphus mauratiana** Lam. (Rhamnaceae). This is the changed specific name for *Z. jujuba* Lam. non Mill. (*Vide* Raizada 1958, p. 515), which is one of the most important and common host of lac insect (Watt 1901, p. 213 ; Glover 1937, p. 137 ; Srinivasan 1956, p. 180 ; Roonwal *et al.* 1958, pp. 17, 19, 27 & 65). But Raizada (1966) uses *Z. mauritiana* again while referring to var. *fruticosa*.

214. **Z. nigra** ? (Rhamnaceae). Host-plant of *T. lacca* at Cambodia. One of the hosts tried with success there (de Flacourt 1927, p. 125 ; Gupta 1962, p. 125). Regarding the name of this plant, Director, Royal Botanic Gardens, Kew, writes: ' this epithet not traced in *Ziziphus* (family Rhamnaceae) '.

215 **Z. nudinervis** Rehd. (Rhamnaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).

216 **Z. spini-christi** Willd. (Rhamnaceae). Host of *L. lacca* recorded from the Oriental region (Sharapov & Prokopenko 1960, p. 19).

217. **Z. vulgaris** Lam. (=*Z. jujuba* Mill.) (Rhamnaceae). Important lac-host at Ellichpur Division and rare host at Wun Division in Berar Circle, India (Stebbing 1910, p. 73).

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The Point Calimere Sanctuary, Madras State—May 1967

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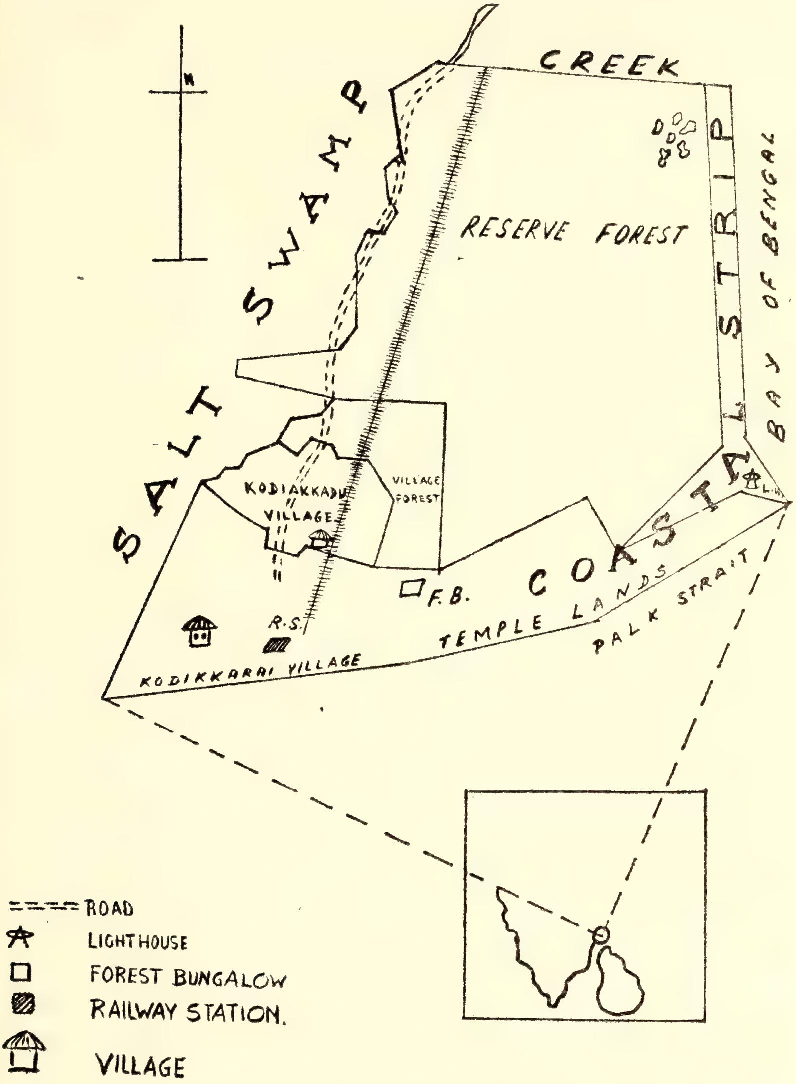
(*With a map*)

INTRODUCTION

The Blackbuck [*Antilope cervicapra* (Linn.)] is unique in several respects. It is an exclusively Indian animal, the only representative of its genus in India, one of the fastest animals in the world, and one of the very few truly plains-dwelling animals of the Indian fauna. The latter habit is apparently the main cause of the alarming and continuing decline in its population, as there is now hardly any open land in the country which is not under some type of cultivation. The large herds which were found in the Gangetic plain and in some parts of the Deccan at the turn of the century have dwindled to a few hundreds in isolated pockets. A recent assessment of their population based on available information (Schaller 1967) leaves no room for doubt that within the next few years the blackbuck will cease to exist except in well-maintained sanctuaries. It is, therefore, very necessary that precise information on the status of this species in different parts of the country be collected as early as possible. It was in this context that a census of the blackbuck in the Point Calimere area was considered. This area is believed to hold the largest number of blackbuck in the south of India. The State Wild Life Officer, Mr. M. A. Badshah, on being approached, offered all facilities and I spent five days in May in the sanctuary observing and censusing blackbuck.

Point Calimere (10° 18′ N., 79° 51′ E.), the *Calligicum* of Ptolemy, is a low promontory on the Coramandel coast, in the Tirutturaipundi Taluk of Thanjavur Dt., Madras State. The only human habitations in the area are Kodikkarai village on the seashore and Kodiakkadu village, further inland. Extensive salt swamps, the winter resort of countless migratory waterfowl, lie to the west of the villages. About three miles east of Kodikkarai village and approximately at the head


N
CREEK
SALT SWAMP
RESERVE FOREST
COASTAL STRIP
BAY OF BENGAL
KODIAKKADU VILLAGE
VILLAGE FOREST
L.H.
F.B.
R.S.
TEMPLE LANDS
PALK STRAIT
KODIKKARAI VILLAGE
ROAD
LIGHTHOUSE
FOREST BUNGALOW
RAILWAY STATION.
VILLAGE

Map of Point Calimere Sanctuary

of the promontory, a lighthouse has been in existence since 1902. A branch line of the Southern Railway from Tirutturaipundi terminates at the station of Point Calimere about a quarter mile from the shore and between the villages of Kodikkarai and Kodiakkadu. This line was laid in 1936, apparently to foster trade with Ceylon, a mere forty miles away across the Palk Strait, but now appears to cater mainly to pilgrims who come to pray at the temple at Kodiakkadu and to bathe in the sea.

We reached Calimere on 22 May and were met by Mr. V. Subbiah, the Range Officer in charge of the sanctuary. The Forest Bungalow situated on the SW. corner of the sanctuary, about 200 yards from the Railway Station, offers an excellent view of the sea and parts of the sanctuary. The sanctuary when fully constituted will have an area of *c*. 6,000 acres or 10 sq. miles of dry thorn scrub jungle and open sea coast, consisting of Kodiakkadu Reserve Forest, the Village Forest and Coastal Strip bounded on the east and south by the sea, on the north by a creek connecting the salt swamps on the west to the sea on the east, and on the west by the road running to the interior from the villages. A tongue of land connects the sanctuary to the salt swamps (Map).

HABITAT

Kodiakkadu Reserve Forest

The Reserve forms the major part of the sanctuary, approximately 4,250 acres of scrub jungle with thorn and other xerophytic vegetation predominating. The forest is not continuous but is intersected by numerous tidal inlets and creeks of varying length and width which were bone-dry in May. Dense thorn-scrub forest of an average 10 to 12 feet height covers the raised land in between the creeks. Dominant trees and shrubs are *Dichrostachys cinerea* Wt. & Ar., *Manilkara hexandra* (Roxb.) Dub., *Memecylon umbellatum* Burm., *Carissa carandas* L.; *Excoecaria aqallocha* L. and other species of Euphorbiaceae; *Cassia fistula* (L.), *Cassia auriculata* L.; *Vitis quadrangularis* Wall., *Capparis zeylanica* (L.) and other creepers are found in profusion and in some parts of the forest, smothering the shrubs and trees and, in May when most of the creepers are dry giving a hoary appearance to parts of the forest. Except in some glades, the result of clear-felling of earlier Casuarina plantations, there was no grass within the forest.

Village Forest

This is contiguous with the Reserve and has an area of approximately 547 acres. Unlike the Reserve, which is not worked by the Forest Department, there is considerable felling, accelerated I believe by the imminent handing over of the forest to the Forest Department. Secondary growth is very evident and thick in some areas.

Coastal Strip

The sea-coast on the south and east of the Reserve is approximately half-a-mile in width and has an area of 812 acres on the south and 370 acres on the east. The southern strip owned by the temple at Kodiakkadu village is being taken over by the Forest Department. The coastal strip is a more or less flat plain with occasional isolated clumps of pandanus and thorn scrub. In the vicinity of the lighthouse there are small elevated areas covered with larger shrubs and a small stand of Casuarina forms a windbreak to the west of the lighthouse. Most of the sea-coast is under grass, and grass-like plants. The predominating species are : *Aeluropus lagopoides* (L.) Trin. (local name *Uppukorai*) a perennial grass of coastal sands very variable in habit and foliage and the sedge *Cyperus arenarius* Retz., a species of the sea-coast from Sind to Ceylon. In shallow, moist depressions the glaucous green, fleshy-leaved, *Suaeda maritima* Dum. occurred in pure stands, and appeared untouched by any animal. Nearer to the sea are to be seen occasional clumps of *Spinifax* sp. Both *A. lagopoides* and *C. arenarius* were very close-cropped and appeared overgrazed.

Potable water in the sanctuary was available only at a water hole dug by the Forest Department in the Reserve Forest. I was informed that chital, when hard pressed, drink at night from the temple tank.

Climate

Temperature data for Calimere are not available. The nearest town Nagapattinam, 35 miles to the north along the coast, has an annual mean temperature of 80°F. and, Calimere probably has a similar climate, the temperature rarely falling below 65°F. and rising above 105°F.

The area gets most of its rain from the north-east monsoon, but is also within the range of the south-west monsoon and the district in some years receives more rain from it than from the former. However, most of the rainfall is between the months of October and December. The town of Nagapattinam receives 54 in. though the average for the district is 44 in. Cyclonic storms of high intensity often occur during the north-east monsoon and in 1952 and 1955 caused extensive damage along the coast.

CENSUS

Most of the blackbuck were said to live on the coastal strip of the sanctuary and only a few within the Reserve. Walks through the major part of the sanctuary confirmed this fact and I felt that fairly accurate estimates could be obtained in the open coastal plains as well as within the forest.

On 25 May, with the assistance of Mr. V. Subbiah, I censused the blackbuck living outside the Reserve and Village forests on the coastal strips of the sanctuary. The distance between the sea and the edge of the forest being nowhere over half-a-mile we were able to cover the whole width of the strip walking abreast at the centre of the strip and when necessary varying the distance between us in relation to the width of the strip. While Mr. Subbiah counted the animals towards the sea, I concentrated on those towards the forest. The animals in between us moved into one or the other counting area as we moved forward. We each had a forest guard with us to inform us if any animal or a herd moved from one counting area into the other. There was no movement from the depth of one counting sector forward into the next, mainly due to the smallness of our party, the slowness of our approach, and the fact that the animals showed little fear of man. Commencing our count from the north-west corner of the sanctuary we walked east along the side of the creek, glassing the inlets from the creek into the sanctuary till we reached the strip of shore on the east of the sanctuary. We then turned south and walked towards the lighthouse, turning west at the lighthouse for the bungalow. The creek shore had no buck and adjoining inlets very few. The east strip had a fairly good number, and the number increased as we approached the lighthouse. The area in the vicinity of the lighthouse and to its west near the casuarina and pandanus held the largest number, which gradually fell off as we approached the bungalow. No blackbuck were seen within about 300 yards of the bungalow.

The next day we walked through most of the forested area visiting areas known to hold blackbuck or likely to have them. The majority of the tidal inlets, creeks, and other open areas within the forest were visited. The blackbuck were more in areas towards the sea than within the forest. We did not see any inside the forests except for a herd near the waterhole in the north-west portion of the Reserve. There were also none in the small area of the sanctuary abutting the great salt swamp in the west. We covered over 85% of the sanctuary during the two days of censusing and the estimates we obtained can be considered as reasonably accurate for the foreshore area which is apparently the preferred habitat. The estimate for the forested area may also express the true position, though the chances of herds or single animals being missed are more in this area.

Results

The actual counts as well as my estimates of the total in the two areas of the sanctuary are given in the Table below.

TABLE

	No. of herds	♂	Sub-adult ♂	♀	Sub-adult ♀	Fawn	Un-sexed	Total	Estimated Total
Foreshore	41	128	24	219	30	23	125	549	600
Forest	6	25	4	66	9	2	4	110	150
Total	47	153	28	285	39	25	129	659	750

I do not think the number of blackbuck in the sanctuary exceeds 800. Age composition data of the animals was also gathered. While it was not difficult to distinguish young males with budding or very small horns, the females were a problem. As in some peripheral herds and others partially screened by vegetation or the lie of the land the young males with budding or small horns could not be satisfactorily separated from the females, all fawn-coloured animals whose sex organs were not visible were noted as not sexed.

Among the 659 animals that were counted 154 (including 25 fawns) or 23% were not sexed. One hundred and eighty-one or 36% of the sexed animals were males, and 153 or 30% were adult. One out of every six was a sub-adult male. Stracey (1960) states that when he visited the sanctuary in 1959 'the darker-coloured males are extraordinarily few and most of the males, which must have constituted about half the numbers, were young buck.' However, I have included among adults, in addition to black, dark brown animals with full-grown horns and three years plus in age, and it is not clear whether 'young buck' of Stracey includes these. Three hundred and twenty-four or 64% were females and 285 or 56% were adults. One out of every 7 female was a sub-adult. The sub-adult animals form 13% of the sexed population and 17% when the unsexed fawns are included in the total. One out of 11 adult females was accompanied by a fawn. But it must be noted that my remarks on the number of sub-adults in relation to adults refer *only* to the sexed population and the unsexed animals being mainly sub-adults, their number in the population may not be so low as the percentages indicate.

The sex ratio is 54 males for 100 adult females, approximately 1 : 2 and 71 sub-adult males for 100 sub-adult females, approximately 1 : 1·5. One of the causes for the reduction in the number of adult males is perhaps poaching.

It is evident from the figures that the majority of the blackbuck live in the foreshore area of the sanctuary. During my visit most of the animals were in herds ranging in size from 3 to 47 but mainly of about a dozen animals. Herds with a single adult male predominated but the largest herd had seven. The foreshore appeared to have been territorially divided among the several herds living in them. In the periphery of the most favoured areas numerous unattached males were seen. Marker defecation sites were common and consisted of pits about a foot in diameter and nearly six inches in depth formed by the pawing of the animal. Dung pellets lay inside and around the pit. Blackbuck in north and central India have two definite peaks in the rutting season, one in April and another from mid-August to mid-October (Schaller 1967), when males establish territories and harems. The habits in south India appear similar. During May the animals were still in breeding herds. No copulation was seen but does were being chased. Herd territories appeared stabilised. My notes record only one fight, on 23 May : ' the herd master-buck and challenger walk parallel to each other ; herd buck walking stiff legged, with tail raised ; both stop and herd buck presents side to challenger which turns ; animals facing in opposite directions ; turn and face each other, muzzles nearly touch ; challenger lowers head, threatens ; herd buck backs ; challenger presents side ; both bring up head, muzzles nearly touch, lower head, engage ; herd buck backing ; disengage ; raise head, muzzles nearly touch ; re-engage '. I was unfortunately seen by the animals at this time and they broke off the fight, the herd buck returning to its harem of 4 females and a sub-adult and the challenger running back the way it had come. I was informed by Forest Department personnel that from November onwards, during the rains, the animals gather in large mixed herds in the coastal area and almost all the animals in the sanctuary are then in that area. This agrees with the formation of large mixed herds during the non-breeding season in north India. The movement of the animals, which normally live within the forested areas, to the coastal strip is probably due to the creeks and inlets filling up with water.

The herds I watched spent the day in feeding and desultory movement in a limited area. Feeding was not restricted to a particular period of the day but was more evident in the morning and the evening. During the hottest part of the day they more often stood quietly or lay down in the hot sun. Cover was not usually used even when available, but I twice saw animals standing in the shade of thorn scrub. The food appeared to be mainly the grass *Aeluropus lagopoides* and the sedge *Cyperus arenarius.* I did not see them browsing. There is no potable water in the coastal area and no movement was seen towards the water hole in the Reserve. Unless they drink sea-water the animals must be spending considerable periods without water. No sign of sickness was seen and most of the animals were in good condition in spite of the forage being sparse. The only evidence of injury we saw was of a buck with a single horn and another limping with its left foreleg.

There are no large predators at Calimere, the jackal being the largest. Jackals and wild pigs are however said to kill and eat a number of newly-born fawns. Jackals are certainly capable of killing adults if so inclined, as indicated by the recorded instance of a pair of jackals killing blackbuck in the Punjab (Hamber 1924). The only other natural control is said to be ' the periodical cyclones and floods which are stated to levy a heavy toll when they do occur ', (Stracey 1960). No sign of dead animals, bones, or horns were seen and the Forest Department personnel also have no records of these.

OTHER ANIMALS

Chital

Chital (*Axis axis*) are said to be plentiful. I saw only five, a female at the edge of the forest at the coastal strip, a magnificent stag in the Kodiakkadu Reserve to the north of the village forest, and a stag and two hinds in the village forest close to the road on the west of the sanctuary. I twice heard the breeding call early in the morning. Both the stags I saw were in hard horn, dark in body colour, and had swollen necks. We also saw a bush in the reserve which had been ' thrashed '. Chital are said to favour the village forest, behaviour that causes concern to the forest officials as the deer can be easily poached in this area. I believe the preference for the village forest is due to the large amount of browse available from the fairly thick secondary growth and the nearness of the two water sources in the sanctuary, the temple tank and the water hole in the reserve. I was concentrating mainly on the blackbuck, and the habitat difference of the two species at Calimere and the density of the scrub suggest that I may have missed most of the chital in the area. I was, however, able to cover a major portion of the forested area and did not see signs that chital occurred in appreciable numbers. I do not believe that there are more than fifty to a hundred chital in the sanctuary.

Wild Pig

Wild pigs are said to be very numerous and local villagers complain that they are unable to plant any root crop or vegetable without having them destroyed by pigs. I saw a sounder of five pigs, inside the Reserve and a solitary animal at the edge of a tidal inlet in the forest. During the census another came out of the forest at a steady trot, the blackbuck moving out of its way, and receiving our wind as it neared the sea, did a U-turn and returned to the forest at the same steady trot. I was struck by the small size of the animals in comparison with the wild boar seen elsewhere in the country, and am uncertain whether the pigs in Calimere are wild or feral. The grasslands of the sanctuary are disfigured by patches ploughed up by pigs in search of the rhizome of *Cyperus arenarius*. I am unable to express an opinion on the number of pigs in the sanctuary.

Miscellaneous

On two days we saw a pair of jackals, possibly the same pair, near grazing herds of blackbuck. The antelope did not appear to be unduly concerned about their presence though they kept a distance between them. Jackals apparently move around during the day contrary to their behaviour elsewhere. Stracey (*op. cit.*) also mentions seeing two jackals during his visit. A mongoose was seen in the forest near the foreshore, and I understand that the Hare (*Lepus nigricollis*) is not uncommon. A few small troops of Bonnet Monkeys [*Macaca radiata* (Geoffroy)] occur in the reserve, all, I am told, expatriates from nearby villages and towns.

Birds

Point Calimere, particularly the vast Vedaranyam Salt Swamp to the south-west, 30 miles in length and 4 to 5 miles in width, harbours large numbers of migratory waders and also flamingos in thousands during the winter months (Sálim Ali 1963). At the time of my visit a few Turnstones (*Arenaria interpres*) in breeding plumage were still in the area. I also saw a small flock of about twenty flamingos feeding in the creek to the north of the Sanctuary. The Grey Partridge [*Francolinus pondicerianus* (Gmelin)] was quite common, a pair or two being usually seen in the vicinity of the bungalow. The call was heard frequently.

CONSERVATION PROBLEMS

Domestic Livestock

During the year 1966-67 the Forest Department issued grazing permits for 836 cattle, 57 buffaloes, 20 horses, and 405 sheep, a total permitted domestic stock of 1318 animals. The sanctuary had in May very few cattle, sheep and buffaloes which are perhaps grazed only during the period of optimum conditions in the rainy season. Small herds (5 to 6 animals) of semi-wild ponies wandered around the grasslands. These are captured only when required by the owners and at other times allowed to roam freely and breed in the sanctuary. In the east foreshore I saw the dry carcase of a cow and domestic stock remains a constant source of danger through disease to the wild animals.

Poaching and other Illegal Activities

Poaching apparently is being brought under control. Poaching, as elsewhere in the country, seems to be largely by officials with weapons. Recent cases were against a village official's son and a police constable for shooting blackbuck. Most of the cases filed appear to be against women firewood-gatherers who go into the forest to collect windfalls and also cut the vegetation when opportunities occur.

Administration

Madras is one of the few States in the country with a separate wild life unit in the Forest Department. The Wild Life Preservation Officer has a staff deputed from the regular forest roster for wild life duty. The Point Calimere Sanctuary is managed by a Range Officer, assisted by a Forester and a Forest Guard. I think the staff is inadequate. Like others of the wild life unit I had met elsewhere in the State, I found Mr. Subbiah keen and enthusiastic and, with some more specialised training, he should benefit the sanctuary considerably.

Comments on the Potentials of the Sanctuary

Blackbuck

The large number of blackbuck in the sanctuary, unusual in the present-day status of the species in India, will continue to increase in importance as conditions deteriorate elsewhere. It is therefore necessary that a continuous effort be made to acquire information on the animals in the sanctuary. The absence of a natural check in the form of large predators suggests that the population may reach a stage when lack of food and diseases resulting from debilitation would either result in their number being drastically reduced or the species being wiped out. Evidence has to be obtained whether the present population has exceeded the carrying capacity of the sanctuary and whether the loss of young through jackals and pigs is sufficient to keep the population within carrying capacity. By periodical accurate estimation of age composition of the population through census, the annual recruitment to the population could be determined. The grazing lands of the sanctuary, excluding the forest, are approximately 3,000 acres in area and sustain a population of approximately 2,500, or very nearly an animal to an acre, of herbivores of varying intake capacity. Admittedly, this large population uses the grazing lands only at optimum conditions but the total effect is definitely not to the advantage of the antelope, the deer, and the sanctuary. The effect of wild pigs is also largely destructive as they feed on the rhizome of *C. arenarius*. Range management problems like these require extended periods of field study for answers to the several questions that arise.

Birds

The migrant waders and the enormous flocks of flamingos that are to be seen in the sanctuary are not only an outstanding attraction to visitors, particularly ornithologists, but also offer excellent opportunities for the study of bird migration. A trial ringing in 1962 resulted in the ringing of 111 birds of 9 species. Among the 57 Marsh Sandpipers (*Tringa stagnatilis*) ringed, two were recovered in Russia. It is hoped that the Government of Madras will agree to the Society's proposal to have a bird-ringing station in the sanctuary.

VISITOR FACILITIES

The forest bungalow at the sanctuary has two suites, accommodation that is quite inadequate if the potential of the sanctuary as a tourist attraction is to be realised. There is no catering and provisions have to be brought in from the town of Vedaranyam six miles to the north. It is necessary that first class hotel accommodation be constructed for foreign as well as Indian tourists.

The Transport facilities are also equally inadequate but can be improved if the Railways are persuaded to attach first class accommodation to their trains during the season from October to March. The nearest airport, is Tiruchirapalli, nearly 100 miles away. However, if a route of the excellent Express Bus service of the State Transport is arranged between Tiruchirapalli airport and Calimere, co-ordinated with the flight timings of the airlines, the sanctuary would benefit.

If these facilities can be arranged and properly publicised the sanctuary should become popular as a tourist attraction.

THE SANCTUARY IN THE HUMAN ECONOMICS OF THE AREA

One of the main reasons for the failure of sanctuaries in India to attain expected standards in the protection of species in them is the hostility of the human population in their surroundings who are denied, at least officially, the economic benefits of the forest produce. The income derived from the sanctuary is also siphoned off into the general revenues and does not benefit the local people. It is time to have a rethinking on sanctuary management so that the local people are offered a stake in the benefits derived from a well-managed sanctuary. Several sanctuaries in Africa have greatly benefited by having the local population interested in their management.

Of the two villages at Point Calimere, Kodikkarai subsists mainly on fishing and Kodiakkadu probably on grazing and employment elsewhere. Apart from the grazing, collection of firewood appears to be the main benefit from the forest to the villagers, situated as they are in an area where fuel for domestic use is not available except in the sanctuary. From the number of cases of illegal firewood collection, most of the conflict with the authorities appears to arise from this source.

I suggest that the Forest Department, retaining full control of the management of the forest and its wild animals, organise for the management of visitor facilities and other ancillary functions a co-operative society, with the major share being held by Government in the Forest Department and the rest by the village panchayats in the area and providing that the profits be used for the general benefit and uplift of the villages.

Employment should be offered as far as possible to people from the villages in the surrounding areas, without however ignoring competence. I am certain that, if such an organization linking the welfare of the people with the sanctuary were to be constituted, there need not be any concern over the existence of the sanctuary and its animals.

MISCELLANEOUS

While visiting various parts of the sanctuary, I was struck by its close resemblance to the pictures I had seen of the habitat of the Wild Ass in the Little Rann of Kutch. The sanctuary may perhaps serve as an alternative home for the Wild Ass, if the need should arise as Stracey (*op. cit.*) suggests. I agree with this suggestion but with much hesitation, concerning as it does introduction of an animal into an area where it has never existed before. I have not examined the Vedaranyam swamp a large part of which may have to be kept as it is, if a large animal such as the Wild Ass is to be kept along with the blackbuck, the main species deserving attention at Point Calimere.

RECOMMENDATIONS

1. The blackbuck, and chital be periodically censused to assess the increase or decrease in their number and if possible the causes.
2. A record of all deaths in the sanctuary be kept and causes noted when available.
3. The carrying capacity of the sanctuary grasslands be investigated on a long term basis by trained personnel.
4. Efforts be made to find alternative grazing areas for domestic stock.
5. Visitor facilities be considerably enhanced on the lines suggested earlier in this report.
6. The sanctuary be given publicity but only *after* the visitor facilities have been improved.
7. A forest co-operative society linking the villages in the surrounding area with the management of the sanctuary be organised.
8. Efforts be made to keep inviolate the Vedaranyam Swamp as far as possible, since the presence of migratory birds is linked with the swamp and in their absence the sanctuary would lose one of its main attractions.

9. Some parts of the sanctuary appear to have an excessive growth of creepers, whether these are detrimental to other vegetation should be examined.

10. The sanctuary may offer an alternative home for the Indian Wild Ass, but only after all points concerning such an introduction have been thoroughly studied.

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Two new species of Sea Anemones (Actiniaria) from Maharashtra

BY

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(*With four text-figures*)

Two new species of sea anemones, namely *Anemonia indicus* and *Acontiophorum bombayensis*, from Maharashtra have been described. The description of each species is based on size-range, coloration, internal anatomical features and size and distribution of nematocysts.

The paper describes two new actinians from a collection of sea anemones made along the coast of Maharashtra, during 1966-67. The specimens were collected from the intertidal region and the observations on nematocysts were made on living material. The anatomical features were studied by dissections and serial sectioning.

Carlgren's (1949) classification is followed and the description of nematocyst types is based on Cutress (1955).

Anemonia indicus sp. nov.

(Text-figs. 1 & 2)

Material. Holotype (Reg. No. P. 1835/1) in the collections of the Zoological Survey of India, Calcutta, collected at Malvan, Ratnagiri District, Maharashtra in March 1966. Paratypes : Fifteen specimens collected from Bombay, Ratnagiri, Vengurla and Redi along the coast of Maharashtra. These will be deposited in the collections of the Zoological Survey of India, Calcutta and the Bombay Natural History Society.

Diagnosis. Actiniidae with wide pedal disc and smooth body, provided with marginal spherules, which are, sometimes absent in the smaller individuals. Sphincter weak, circumscribed or rather well-developed, diffuse. Tentacles usually long, as a rule not covered by the upper part of the column, their longitudinal muscles ectodermal. Siphonoglyph variable in number, not always connected with directives. Numerous perfect mesenteries. Diffuse retractors. More mesenteries at the base than at the margin. Cnidom : Spirocysts, atrichs, basitrichs, microbasic p-mastigophores (and possibly sometimes, holotrichs).

Description

General features. Anemonia indicus, is a medium-sized, soft-bodied actinian. In life, the column is pillar-or hour-glass-like in form. The anemone is most frequently found attached to oyster shells and occasionally to the tube of the polychaete, *Onuphis* sp., shells of the bivalve *Coecella* sp. as well as to submerged concrete structures. Solitary to gregarious in habit. Algae present in the endoderm.

Size. The species has the following size-range : Length of the column 15-75 mm., diameter of column 10-15 mm., diameter of oral disc 20-60 mm., diameter of basal disc 20-60 mm.

Colour. Column green with brown longitudinal stripes. Oral disc and tentacles light-green with radial and transverse brown stripes. Basal disc dirty-white in preserved anemone. Some specimens have darker shades of green and brown.

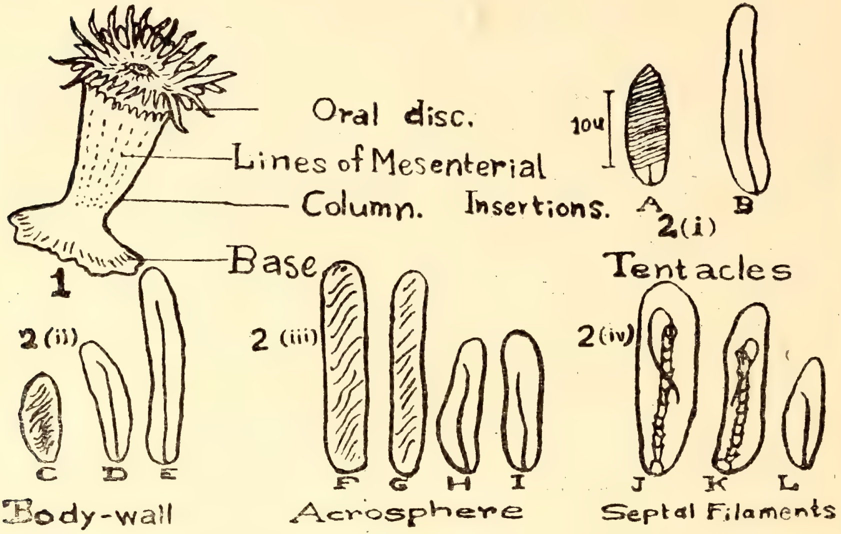
Basal Disc. Strongly adherent, well-developed and generally circular in outline, the diameter equal to that of the oral disc but always more than that of the column. Basal disc translucent in the living anemone.

Column. Not divisible into scapus and capitulum, pillar-like when extended, sometimes hour-glass-like. A deep fosse present. Column smooth, semi-transparent and without cinclides. Longitudinal lines of mesenterial insertions are clearly visible through the body-wall.

Oral Disc. Large, flat to concave, wider than the diameter of the column. Regular in outline with a beautiful design formed by the radial dark green or brownish stripes. Lips ribbed, sometimes raised to form a cone above the surface of the disc. Two siphonoglyphs present. Mouth of moderate size and non-protuberant. Radial muscles of the disc, ectodermal.

Tentacles. Up to 192 in a full grown anemone. Long, thin and tapering to a point. Tentacular arrangement is regularly hexamerous. Six cycles of 6, 6, 12, 24, 48, 96 tentacles in a full grown specimen. Marginal spherules (acrosphere) present, but in young specimens they may be less developed or absent. In some, the spherules are lobed. Inner tentacles longer than the outer ones. V-shaped green or brownish marks, on the surface alternating with white patches on the wall facing the oral region. Longitudinal muscles ectodermal.

Mesenteries. Many, perfect mesenteries not divisible into macro- and microcnemes. Retractors fairly strong and diffuse. Well-developed parietal muscles. Sphincter well-developed and diffuse. In section the sphincter is broadest at margin and gradually tapers to a tail. Mesenteries developing from the base. Sexes separate.


Oral disc.
Lines of Mesenterial
Column.
Insertions.
Base
1
10µ
A
B
2(i)
Tentacles
2(ii)
C
D
E
Body-wall
2 (iii)
F
G
H
I
Acrosphere
2(iv)
J
K
L
Septal Filaments

Text-fig. 1. *Anemonia indicus* sp. nov., a well developed specimen.

Text-fig. 2. Cnidom of *Anemonia indicus* sp. nov. (i) *Tentacles*: (A) Spirocysts (B) Basitrichs; (ii) *Body-wall*: (C) Atrichs (D) Basitrichs (E) Basitrichs; (iii) *Acrosphere*: (F) Atrichs (G) Spirocysts (H) Basitrichs (I) Basitrichs; (iv) *Septal Filaments*: (J) Microbasic p-mastigophores (K) Microbasic p-mastigophores (L) Basitrichs.

Cnidom. The distribution and size (in μ) of nematocysts are as follows:

Tentacles :	
Spirocysts (A)[1]	9·8 - 19·6 × 1·4 - 2·8
Basitrichs (B)	18·2 × 2·1 - 2·8
Body-wall :	
Atrichs (C)	8·1 - 11·2 × 1·4 - 2·1
Basitrichs (D)	14 - 18·2 × 2·1 - 2·8
Basitrichs (E)	22·4 - 23·8 × 4·2
Acrosphere :	
Atrichs (F)	29·4 - 49 × 2·8 - 4·2
Spirocysts (G)	14 - 15·4 × 2·1 - 2·8
Basitrichs (H)	14·7 - 21 × 2·1
Basitrichs (I)	9·8 - 11·2 × 1·4
Septal filaments :	
Microbasic P-mastigophores (J)	18·2 - 21 × 3·5
Microbasic P-mastigophores (K)	12·6 - 14 × 4·2
Basitrichs (L)	8·4 - 9·8 × 1·4

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[1] Reference to text-figures.

Remarks. Amongst the 8 species of the genus *Anemonia*, recorded so far, only *Anemonia natalensis* Carlgren (1938) bears some resemblance to this species but the distribution, size, and form of nematocysts are clearly different from *A. natalensis*.

Acontiophorum bombayensis sp. nov.

(Text-figs. 3 & 4)

Material. Holotype (Reg. No. P. 1834/1) in the collections of the Zoological Survey of India, Calcutta, collected at Madh Island, Bombay City, Maharashtra, in October 1966. Paratypes : Five full grown specimens from the same locality which will be deposited in the collections of the Zoological Survey of India and the Bombay Natural History Society.

Diagnosis. Acontiophoridae with well-developed base. Column smooth, cinclides present. No sphincter. Tentacles of ordinary length, hexamerously arranged. Longitudinal muscles of tentacles and radial muscles of oral disc, ectodermal. Two siphonoglyphs. Mesenteries divisible into macro- and microcnemes, more numerous proximally than distally. Two pairs of directives. Macrocnemes, including the directives, fertile, with very strong retractors. Parietobasilar muscles very weak. Basilar muscles distinct. Cnidom : spirocysts, basitrichs, microbasic p-mastigophores and probably microbasic amastigophores.

Description

General features. A very small sized anemone. When alive, the extended column is cylindrical. The anemone usually lives in association with the wood boring mollusc, *Martesia* sp. but also occurs on the shell

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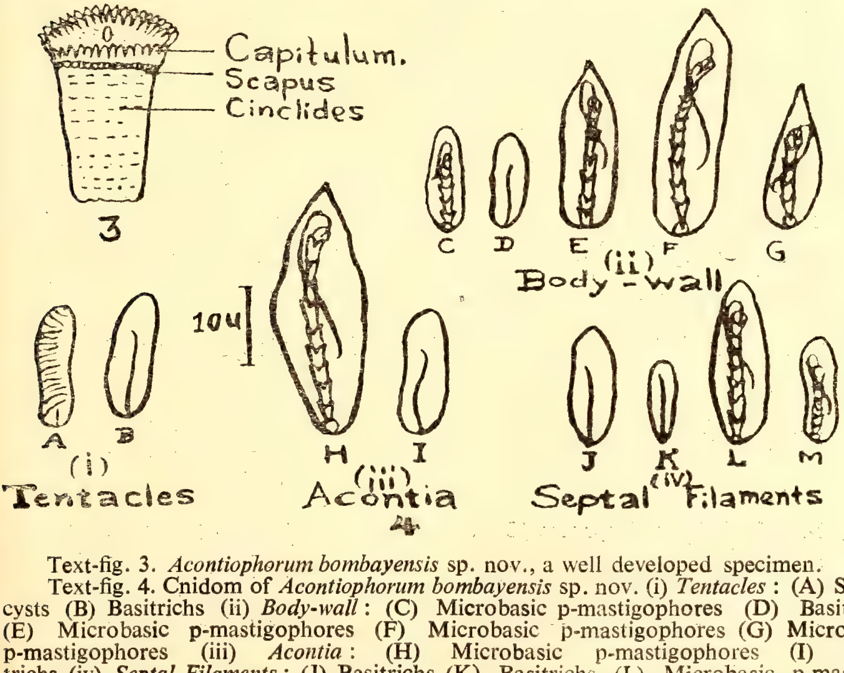

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Text-fig. 3. *Acontiophorum bombayensis* sp. nov., a well developed specimen.

Text-fig. 4. Cnidom of *Acontiophorum bombayensis* sp. nov. (i) *Tentacles* : (A) Spirocysts (B) Basitrichs (ii) *Body-wall* : (C) Microbasic p-mastigophores (D) Basitrichs (E) Microbasic p-mastigophores (F) Microbasic p-mastigophores (G) Microbasic p-mastigophores (iii) *Acontia* : (H) Microbasic p-mastigophores (I) Basitrichs (iv) *Septal Filaments* : (J) Basitrichs (K) Basitrichs (L) Microbasic p-mastigophores (M) Microbasic p-mastigophores.

of the barnacle, *Balanus tintinnabulum*. Gregarious due to asexual reproduction by pedal lacerations. Algae present in the endoderm. An uncommon to rare species.

Size. The largest, well-extended specimen has the following dimensions. Length of the column 18 mm., diameter of column and basal disc 10 mm., diameter of oral disc 15 mm.

Colour. Column and oral disc green. Capitulum translucent to light-green. Cinclides on the column, dark green, but at times, yellowish or even light-red. Tentacles light-pink. Basal disc dirty-white.

Basal Disc. Moderately adherent, well-developed and almost circular in outline. Diameter equal to that of the column but sometimes smaller.

Column. Short, columnar when fully expanded. Divisible into scapus and capitulum. Column studded with longitudinal rows of coloured cinclides. Capitulum without cinclides. Acontia not readily discharged.

Oral Disc. Flat, broader than column when expanded. Radial muscles of disc and longitudinal muscles of tentacles, in the ectoderm. Two siphonoglyphs. Mouth protuberant. Tentacles cover more than peripheral one-third of the disc.

Tentacles. 3-4 cycles, arranged hexamerously. Short, smooth with rounded tips. All tentacles of more or less equal size. Longitudinal muscle layer of tentacle, when contracted, thrown into prominent folds.

Mesenteries. Two cycles of perfect mesenteries, with well-developed diffuse to circumscribed retractors in the distal region. Parieto-basilar muscles well-developed. Mesenteries developing from base upwards. Algae (zooxanthellae) present in the whole column and mesenteries. Sphincter absent. Acontia short, thick and light-pink in colour, elliptical in transverse section and without fin. Acontia more than twice as thick as filaments and containing few nematocysts and numerous gland cells. Nematocysts of acontia are distinctly larger than those of filaments. Asexual reproduction by pedal lacerations.

Cnidom. The distribution and size (in μ) of nematocysts are as follows:

Tentacles :	
Spirocysts (A)[1]	8·4 - 21 × 2·1 - 4·2
Basitrichs (B)	15·4 - 18·2 × 2·1 - 2·8
Body-wall :	
Microbasic P-mastigophores (C)	16·8 - 19·6 × 2·8 - 4·9
Basitrichs (D)	9·8 - 15·4 × 1·4 - 2·1
Microbasic P-mastigophores (E)	19·6 - 23·8 × 4·2 - 4·9
Microbasic P-mastigophores (F)	28 × 4·2
Microbasic P-mastigophores (G)	16·8 - 19·6 × 2·8 - 3·5

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[1] Reference to text-figures.

Acontia :	
Microbasic P-mastigophores (H)	33·6 - 42 × 5·6 - 7·7
Basitrichs (I)	16·8 × 1·4 - 2·1
Septal filaments :	
Basitrichs (J)	15·4 - 18·2 × 2·8 - 3·5
Basitrichs (K)	5·6 - 7 × 1·4
Microbasic P-mastigophores (L)	28 - 33·6 × 3·5 - 5·6
Microbasic P-mastigophores (M)	7 - 8·4 × 1·4

Remarks. The genus *Acontiophorum*, has so far been represented by a single species, *Acontiophorum mortenseni* Carlgren, reported from South Africa (Carlgren 1938). From the distribution and shape of nematocysts, there is no doubt that the new species, belongs to the genus *Acontiophorum*. The distribution and size of the nematocysts of *A. bombayensis* are different from those of *A. mortenseni*.

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Reviews

1. THE DEER AND THE TIGER. By George B. Schaller. pp. 370 (16×24 cm.). With 30 photographs, 17 figures and 58 tables. Chicago and London, 1967. The University of Chicago Press. Price $10·00 or 72*s*.

Until recently Dunbar Brander was indisputably the greatest authority on the natural history of the larger mammals of central India, and this forest officer deserves considerable credit for having produced as early as 1923 (in the era in which big game hunting was in vogue and when the sciences of ecology and animal behaviour had hardly been discovered) a book which could last as long as it has done. His observations, however, were not sustained over a long and continuous period nor conducted in any particular selected area; and moreover most of his information was obtained while actually engaged either in forest duties or on *shikar*.

The recent advent on the Indian scene of Dr. George Schaller has changed all this. For the first time in this subcontinent, a dedicated scientist has remained almost continually for 14 months in what is probably the finest remaining natural habitat for wild life anywhere in Asia, for the centre of Kanha National Park in Madhya Pradesh holds the largest concentration of hoofed animals and feline predators. And although the place is cut off in the monsoon by swollen rivers thus proving an unpopular posting for subordinate forest staff (as the reviewer was told by the staff themselves), the author of this book under review stayed there throughout the 'unpopular' season with his wife and two young children, armed with nothing more lethal than binoculars, note-book and camera, in order to conduct the studies which have produced this remarkable book.

Not only are the description and geographical and ecological distribution given in detail of each species, but also its population dynamics, general behaviour and social behaviour; and the book contains a wealth of factual data which almost bewilder the reader in the revelation of the amount of time and hard work involved. It was the reviewer himself who recommended Kanha as a study area in preference to Corbett National Park, and on a visit there to meet the author he was amazed at the amount of detailed observation that could be made and noted down in note-book at the sight of a small herd of chital moving across the *maidan*, or a herd of gaur peacefully grazing at the edge of the *sal* forest.

Perhaps the most important conclusion reached by the author is the one concerning swamp deer (what a pity he uses the local name *barasingha* and not the all-India and all-world one!). He found that although predation by tigers was a contributory (and of course natural) cause of the decline in the population of this splendid deer, two other reasons were poaching and a decreasing birth rate probably due to a disease such as brucellosis, whereby the young are aborted. Considering all the factors, he suggests that the present level in the numbers of tigers is about right for Kanha, but that human predation is reducing the deer population and must be stopped, as well as any possible diseases of the swamp deer be prevented or cured.

The author has conclusively settled the controversy as to whether the time of antler-growing and rutting of chital is seasonal or non-seasonal. He found at Kanha that although chital shed antlers and were in hard horn (and therefore rutting) at all times of the year, there was a definite peak period; and that this peak period varies slightly in Rajasthan and Uttar Pradesh where he also collected some information.

In the past there has been too much erroneous and often anthropomorphic over-simplification of the intraspecific interactions of various species of wild animals. For instance even Brander stated that 'the stags fight for hinds', whereas in fact fighting and other such interactions are primarily related to dominance, with the result, of course, that a high-ranking stag has priority over receptive hinds. Regarding gaur many writers (including Brander) in the past have described how gaur master bulls are ousted from the herd by younger and stronger rivals and are often doomed to lead a solitary life. Schaller did not find this, and says 'Rather than on strength, bulls base their rank primarily on size. The relative position of the bulls in the hierarchy changes constantly and requires frequent readjustment as some join and others leave of their own volition'.

The book is superbly illustrated by a number of black-and-white photographs taken by the author: in nearly all of these the animals are doing something interesting that is also illustrative of their behaviour such as head-up display, sparring, lateral display, leading and following, spraying scent (of tigers) and so on.

The author made his name with his first scientific book THE MOUNTAIN GORILLA (1963), which was followed by a 'popular' edition THE YEAR OF THE GORILLA. His present THE DEER AND THE TIGER is a book which should be in every college and school library, and also in the homes of everybody concerned with natural history, conservation, forestry and sport. Unfortunately it is rather costly as far as India is concerned, and it is to be hoped that a cheaper edition can somehow be produced.

In the opinion of the reviewer this superb book should be a textbook in every forest and zoology college: in fact it is tempting to refer to the dictum of a former Inspector-General of Forests in India who used to emphasise that 'No forest officer is fit to take charge of a forest division until he has shot a tiger'. It is certain that, with the present decline in the numbers of tigers in this country, this distinguished retired officer (who is also one of our leading wild life conservationists) would be the first now to recommend that THE DEER AND THE TIGER be read and studied by every forest officer—both before and after taking charge of a division.

We are indebted to the School of Hygiene and Public Health of the Johns Hopkins University in the United States of America for financing and sponsoring the author's research work in India. Needless to say, the sponsors and the author have no motive other than to provide 'a solid body of facts' so that 'conservation and management practices satisfactory to man, his livestock, and the wildlife' can be 'initiated in time to save the last from complete extermination'.

This is shown in the concluding paragraph of the book, where the author states 'The evidence presented in this report . . . indicates that poaching and not tiger predation has been the general cause of the decline of the wildlife in the park. The most effective means of managing the tiger is obviously to manage the prey, which in turn means (1) curtailing the activity of poachers, and (2) limiting and gradually eliminating all livestock from within the boundaries of the park . . . . Kanha Park is part of India's cultural heritage, a heritage in many ways more important than the Taj Mahal and the temples of Khajuraho, because, unlike these structures formed by the hands of man, once destroyed it can never be replaced'.

E. P. G.

2. SOCIAL COMMUNICATION AMONG PRIMATES. Edited by Stuart A. Altmann. pp. xiv+392 (24×16 cm.). With 49 black and white plates and 81 figures and many tables. London, 1967. The University of Chicago Press. Price 5 gns. net.

During the past 10 years no order of mammals has been more intensively studied in the laboratory and in the field than the Primates. This interest is reflected in the large number of symposia on primate behaviour, and, at present, the spate of books on the topic. The present volume consists of 17 papers given in December, 1964, at a symposium entitled 'Communication and social interaction in Primates.' The papers are more or less arbitrarily arranged into 5 parts under the headings reproductive behaviour, agonistic behaviour, causal mechanisms, social dynamics, and communication processes. As is the case with most symposia treating a broad subject, the papers vary so in outlook and treatment that it is not easy to arrange them logically into a well-integrated volume. Although the editor has made a good attempt to tie the material together with a general introduction and conclusion and discussions—some useful, some not—at the end of each part, the overall effect of the volume is still that of a series of miscellaneous papers under one cover.

The value of the individual papers varies tremendously, ranging from seeming progress reports and summaries of work published elsewhere to detailed results of major projects. Several of the papers are based on studies of primates in their natural environment. Petter presents a few notes on the rare aye-aye of Madagascar, and Jolly discusses the synchronous breeding of *Lemur catta.* Sugiyama describes group composition, home range size, and social organization of the common langur at Dharwar, Mysore State, the only study of an Indian monkey in its natural habitat in this book. Several male leaders of the langur groups studied by Sugiyama were replaced by more aggressive intruders, and in all but one instance the new male killed all the infants less than one year old, a unique and puzzling behaviour. Ripley presents details of the largely aggressive interactions between Ceylon grey langur groups at or near their home range boundaries. Struhsaker catalogues the 36 more or less distinct vocalizations of the African vervet monkey, using spectrographic analyses, in the most thorough study of its type to date. Tsumori summarizes, among other data, some of the fascinating research carried on by the Japan Monkey Center on the acquisition of new food habits by free-living but tame Japanese macaques. For example, when the monkeys were given sweet potatoes to eat, they began to wash these in water. 'In 1953 a female first tried potato washing, and by 1962, this behaviour had been picked up by all the troop members except newly born infants, 1-year-old infants, and adults more than 12 years old.' The newly-acquired behaviour is now being handed down from generation to generation.

Two studies treat the introduced but free-ranging macaques on Santiago Island near Puerto Rico. One, by Kaufmann, presents detailed quantitative data on social relations between males in a group, particularly their linear dominance hierarchy and the effect of status of the frequency of agonistic and grooming interactions. The other, by Sade, investigates the factors determining dominance in a group and comes to the conclusion that an offspring's rank is partly determined by the rank of its mother.

Of the studies based on both captive and wild monkeys there is one, by Rowell, discussing the correlation between the large perineal swelling in adult female baboons and the amount of sexual behaviour; a second, by Kummer, describing social interactions evolving three Hamadryas baboons simultaneously; and a third, by Hall, noting the kinds of interactions between the male and the females in a group of African patas monkeys.

Several projects were done solely in the laboratory. Rosenblum and Kaufmann give a brief account of mother-infant relations in pigtail and bonnet macaques; Jensen *et al.* describe the loosening of the social bond between pigtail macaque females and their offspring; and Ploog analyses primarily the genital display of the South American squirrel monkey, a species in which the erect penis of the male is in certain situations a social sign stimulus rather than an indication of sexual behaviour. Miller studied the capacity of one rhesus macaque to respond to the nonvocal cues of another one by means of instrumental conditioning to avoidance and reward stimuli. Robinson inserted electrodes into various parts of the brain of the rhesus macaque to study the localization of electrically evoked vocalizations.

In the final paper, Altmann 'attempted to clarify the basic nature of social communication, discuss structural properties of social communication systems and review relevant data on the structure of primate behaviour, discuss criteria for establishing natural classifications of behaviour, and present an outline of a mathematical model of metacommunication'. The volume would have benefited from more broad and theoretical papers of this type.

This, in brief, gives an indication of the topics treated in the volume. The papers not only represent a good cross-section of the type of research being done on primates by anthropologists, zoologists, and psychologists, but they also illustrate well the highly quantitative way in which animal behaviour problems are currently being approached. In these respects, the volume is a useful reference work. It is also convenient to have the papers under one cover, rather than scattered in various journals, but the price of convenience as always is high—15 dollars in this instance.

G. B. S.

3. THE AFRICAN ELEPHANT. By Rennie Bere. pp. 96 (20·5×21·5 cm.). With 57 black and white photographs and 16 pages in colour. London, 1966. Arthur Barker Limited. Price 21*s.* net.

THE AFRICAN LION. By Mervyn Cowie. pp. 96 (20·5×21·5 cm.). With 58 black and white photographs and 16 pages in colour. London, 1966. Arthur Barker Limited. Price 21*s.* net.

Two very interesting books of a popular series THE WORLD OF ANIMALS of just under 100 pages each with more illustrations than text. The selection of photographs both in colour and black and white from various sources could hardly be bettered. They are of excellent quality and beautifully composed, portraying the animals in the appropriate setting and pose to illustrate a particular characteristic. The unusual format of the books is well adapted to give adequate dimension to the many full-spread photographs, without losing detail.

Both authors are knowledgeable game officials who could have treated their subjects at much greater length. But they are restricted by the purpose of the books—that of introducing the animals concisely to the intelligent lay reader and a few short chapters about the history of the animals, their family and social life, their population and food problems and their relation with their environment including other animals and man. The happy result is that only the essential and more interesting aspects of these two very interesting animals are presented.

THE AFRICAN ELEPHANT. The study of the animal's yet little known behaviour is as fascinating as its nose, whose most versatile utility as a prehensile limb of immense power we usually take for granted. The fussy mother uses it to steer her young by its tail or lash it into squealing obedience when recalcitrant. It can suck up two gallons of water, either for a drink or a shower bath and then act as a dust gun to powder the animal's vast expanse. Compared with this country, the elephant population of Africa is still immense and with the shrinking habitat, embarrassingly concentrated. The author records seeing some years ago in Uganda 'a big herd of six or seven hundred strong . . . . . acres and acres of elephants . . . . . and the whole time the interminable thunderous rumbles of their bellies'. Actually this sound is emitted from the throat and trunk when elephants are feeding and can be heard a mile away.

THE AFRICAN LION. A no less interesting a beast, its amazing intelligence and adaptability especially of the females who do most of the killing, is displayed in their planned and co-operative hunting techniques and in the care of their young.

The male of the species, to us a symbol of power and majesty from time immemorial, is very appropriately termed the 'Lord of Beasts'. The nobility of his features is set off and enhanced by the mane, a magnificent though sometimes vermin infested adornment. His thunderous voice which can carry for five miles and proclaim his supremacy in a ten mile territory is 'the most thrilling of sounds in Africa . . . . . every plant and pebble seems to be electrified by its resounding echo'. Then he loves to relax and 'is one of the few wild animals that really goes to sleep. . . . sometimes turning on his back with all four feet in the air'. Of course he is polygamous. His lionesses, in addition to their other family chores, usually supply the master with his meals, and it goes without saying 'he insists he must be served first'. Verily every inch a Lord.

A chapter on lions and witch craft reveals widespread superstition about Magical relations between lions and men. Many gruesome practices are connected therewith and it is likely that a number of ritual murders are attributed to imaginary man-eaters. Witch-doctors claim with some evidence that they can control lions and make them attack a chosen victim or his livestock. While dismissing telepathy, the author thinks that lions may be led to a desired spot by laying a scent trail or even by conditioning them to respond to a sound signal in a particular way.

D. J. P.

4. A BIRD OVERHEAD. By Clive Simson. Illustrated with plates and drawing by R. B. Talbot-Kelly. pp. 174 (14×22 cm.). London, 1966. H. F. & G. Witherby Ltd. Price 30*s*.

This is a collection of essays, mostly relating to personal experiences with birds in Britain, Iceland, and other places in western Europe. Though primarily an oologist, the author is at the same time a careful observer and many of his notes are of considerable natural history interest. In the three chapters on the cuckoo, he examines the evidence for and discards the oft-repeated statement that the egg is carried to and put into the nest, as accepted by Stuart Baker for Indian cuckoos in CUCKOO PROBLEMS. It is possible that different races have different habits; but the reviewer cannot help drawing attention to a recent note in the *Bulletin of the British Ornithologists Club* in which the eggs recorded as of the Rail (*Rallina fasciata*) in Stuart

Baker's NIDIFICATION OF THE BIRDS OF THE INDIAN EMPIRE are now said to be of a Crow-Pheasant—a fact which stresses the need for a critical re-examination of many Indian notes and records.

The chapters on Wild Duck Farming in Iceland and The Collared Dove (the Ring Dove which has reached England in its very recent western invasion) are of particular interest.

The book is an excellent example of the extent and nature of interest in birds, prevailing in England—it is doubtful if one could find a publisher, or a writer, on these lines in India.

H. A.

5. THE WORLD OF REPTILES. By Angus Bellairs and Richard Carrington. pp. 153 (14×21·5 cm.). With 31 black and white photographs and one coloured; 26 text-figures. London, 1966. Chatto and Windus Ltd. Price 25*s*. net.

This book is an attempt to give the layman and the amateur naturalist an idea of reptiles in general and the various forms with examples from each. The opening chapter deals with the main characteristics of reptiles, the features which distinguish them from certain morphologically similar fish, amphibians and mammals, their physiology, embryonic development, anatomical features and evolutionary background. In the succeeding chapters each major group of the Class Reptilia is described in detail and an amount of valuable information is furnished in a very attractive manner. The combination of factors which determines the different types of reptiles is clearly described.

Examples are provided for each group, and the typical ones are elaborately described. All the living Orders including Rhynchocephalia containing the celebrated 'living fossil' Tuatara are treated in sufficient detail to conform to the scope of this work.

The plates are superb and certainly augment the value of the book. A useful guide to the beginner is an appendix giving a short introduction to the modern system of naming and classifying animals and brief classification of the present day reptiles, down to the family.

The book adequately fulfils the authors' intention to create interest in the world of reptiles among their readers and to encourage some of them to take up the study of the reptiles, at least as a hobby. A good bibliography is given to benefit those who would like to know more about the reptiles or do a systematic study of them.

B. R. G.

6. THE LIFE OF INSECTS. By Vincent B. Wigglesworth. pp. xii+360 (24×16 cm.). Numerous photographic plates, monochrome and in colour, and line drawings. London, 1964. Weidenfeld and Nicolson. The Weidenfeld and Nicolson Natural History. Price 55*s.* net.

THE LIFE OF INSECTS by Prof. V. B. Wigglesworth is fascinating reading and deservedly reached its second impression within two years of publication. The price is somewhat high for the average Indian pocket, but the book is good value for the money and ought to find a place in every high school and college library and in our public libraries. It works systematically through the life of the insect, from insects as inhabitants of earth, air and water, through dietary, mating, reproduction and growth, luminosity, colours, defence and offence, vision, hearing, smell and other senses, behaviour, organisation of insect societies, and populations, speciation and migration, to the relationships of insects with flowers and man, and is rounded off by a catalogue with brief notes on the 28 Orders of insects, a chapter-by-chapter bibliography, and a glossary of technical terms. The book is packed with interesting facts illustrating whatever theme is under discussion. Confident of plenty of material to choose from, the author does not waste his words; he is brief and to the point, without any sacrifice of clarity. Except for a few technical portions there is nothing that an intelligent person reading with interest will find difficulty in understanding. The photographs and line drawings add materially to the clarity and attractiveness of the book.

D. E. R.

7. AN INTRODUCTION TO THE BEHAVIOUR OF ANTS. By John H. Sudd. pp. viii+200 (22·5×15 cm.). London, 1967. Edward Arnold Ltd. Price 40*s.* net.

The author brings together in this book the various observations and interpretations on ant behaviour expressed by innumerable writers on the subject. The task is very laborious indeed considering the vast literature on the subject—more than 450 books and papers have been referred to—and variety of ant species, each having its own peculiarities. He has discussed the sense organs, various methods of making nests and their types, procurement of food and feeding habits, organisation and maintenance of colonies chapter-by-chapter, quoting authorities for each and has ended with a chapter on the evolution of their social behaviour. The reader will find in this handy book almost everything on ant behaviour and the detailed references given at the end will help him to get more literature, if one wants to go into greater details. The figures and line drawings given in the text prove an excellent asset in clearly understanding the text.

N. T. N.

8. THAT WE MAY LIVE. By Jamie L. Whitten. pp. vii+251 (23·5×15·5 cm.). New Jersey, 1966. D. Van Nostrand Company, Inc. Price $ 4.50.

This book is an attempt to show that the dangers of pesticides and insecticides have been grossly overstated by the school of ecologists who plead the necessity of maintaining the balance of nature, and the author appears to feel that as the Captain of Creation it is man's function to maintain the artificial balance, and tilt it in his own favour as best as he can. 'Ours is the only nation' he says 'where the cost of food averages only 18% of our disposable income' as against 36% in West Germany and 50% in the USSR. Between 1940 to 1964 the production of corn, wheat and beef increased by 60% despite a reduction in farm acreage, and despite the fact that less than 8% of people are engaged in agriculture. If pesticides alone cannot take credit for this increased productivity, they nevertheless, contribute significantly to this increase. A report of the National Academy of Sciences says 'that without the use of chemical pesticides, most fruits and vegetables would be scarce in the market and the price . . . . . would be prohibitive'. Since America now feeds, at least marginally, a great part of the developing world, these facts must be treated with the respect they deserve. Again, medical science is largely sustained by entomologists and other scientists who supported their work by isolating the causes and by developing techniques of controlling by synthetic means fleas, rats, flies, mosquitoes and other carriers of deadly diseases.

The author, Congressman Jamie L. Whitten, was chairman of the House Appropriations Sub-Committe on Agriculture, and for the preparation of this report over 185 outstanding scientists and 23 physicians were interviewed, apart from several belonging to every discipline including Biochemists, Zoologists, Geneticists, Pathologists. Curiously, in spite of the impressive list of reports and documents cited to prove his point, the effort is unconvincing, and one reason for this is perhaps that in the midst of erudition one finds naive statements like this for example: 'Man today stands on the brink of controlling the air above us and the elements about us. The man who developed the atomic submarine recently told me that in future wars the nation which controlled the bottom of the sea might well emerge the victor'. Well, it may be questioned whether life would be worth living if to survive on the surface of the globe where man is meant to live it should be necessary for him to conquer the bottom of the sea as well.

A whole chapter has been devoted to SILENT SPRING, and to proving that Rachel Carson's book though necessary as a warning to the indiscriminate use of pesticides, yet drew unscientific conclusions from many unrelated facts and that she has put forward an entirely one-sided case. The author quotes from an Editorial of the *Washington Evening Star*, but appears to have missed the Central message of the quotation: 'It seems . . . . that Miss Carson's detractors have missed the point of her book. What she wanted to do—and did do—was to jolt Americans out of their apathy towards the dangers of the indiscriminate use of pesticides . . . . her book warned human beings of the dangers of becoming victims if not directly, then indirectly of their own ingenuity'. The author has marshalled an enormous number of facts which do not help to invalidate the basic philosophy of SILENT SPRING.

Z. F.

9. DAWN DUSK AND DEER. By Arthur Cadman. pp. 138 (24×16 cm.). London, 1966. Country Life Limited. Price 36*s*. net

Though the central theme of this book is Deer in Britain, it ranges discoursively over other associated wild life and their habitat. Written feelingly in simple unsophisticated style it makes very informative yet pleasant and easy reading.

The author, a Deputy Surveyor of the New Forest, and an official of Britain's Forestry Commission, both by profession and inclination an outdoor shooting man and naturalist deeply moved by the beauty of the wilds and its creatures. The type though universal is, to the non-shooting nature lover, an incomprehensible paradox, to understand which it is worth digressing.

Consider the modern approach to anthropology where it is thought essential that a student should not remain a patronising outsider, but as far as possible be a part of the primitive community he is studying, and share its life and ways. Similarly, the sportsman-naturalist is or has been a part of wild life, albeit as a predator, a role that is integral to nature's economy. His feeling of oneness with nature is real and intimate. He develops an intense attachment to that environment where he feels he belongs and reacts violently to the threat of its destruction. This is the reason, I think, why so many sportsmen turn out to be such single-minded conservationists and keenly perceptive naturalists with an eye that sees more than the apparent.

I hope I do not create the impression that the book is only about shooting deer. As the author says it is 'a book about their habits and paths and the many incidents which may be expected while watching them' mostly at dusk and dawn, the most likely time for meetings between man and beast.

The author has learnt much by following the diction 'sit still, look long, and hold yourself quiet' conditions he advises as essential to produce the rare and unexpected experience—a magnificent buck with a robin perched on his antler, or an ill-fated poacher sauntering unknowingly into a Forestry Official.

Except for a few chapters which give us facts about deer, no particular aspect of Britain's natural history is developed systematically. Instead the author, with the keen perception of a professional Forester and the sensitivity of a nature lover recounts anecdotes of particular experience ranging over many years and many places, from stalking stag on the Highlands to taking a deer census in the New Forest.

In spite of extensive shooting, deer in Britain are on the increase and rapidly extending their range to a degree where they have to be controlled to restrict numbers and maintain healthy stock. Which shows what sensible and well enforced game laws can do even in a small and highly industrialised country.

Incidentally our Barking Deer originally introduced by the Duke of Bedford at Woburn has established itself in the country and is found in places far removed from Woburn.

D. J. P.

10. ILLUSTRATIONS TO THE FLORA OF DELHI. By J. K. Maheshwari. pp. xx+282 (24×16 cm.). With 278 figures. New Delhi, 1966. Council of Scientific and Industrial Research. Price Rs. 28 or 56*s*. or $ 8.00.

This forms the companion volume to the FLORA OF DELHI by the same author and publisher (1963). Full page illustrations of 278 species out of a total of about 980 species treated in the FLORA OF DELHI form the bulk of this volume. It also contains 17 corrected plant names besides 37 reports of new records to the Delhi flora.

There is a great dearth of illustrated floras in India and it is indeed gratifying to see the issue of this *pro parte* illustrated Flora of Delhi. The illustrations of plants prepared by Shri D. M. Sonak during the preparation of the author's Flora of Delhi are published in this volume. The illustrations are prepared according to scales and are original. In most cases even the underground parts are drawn. Each plate bears reference to the page of the parent work and explanations to the figures. Although the illustrations cannot be said to be of high artistic merit, there is no doubt that they are very useful for confirming the identification of the species which are illustrated here, both for students and laymen.

It is to be hoped that either the Council of Scientific and Industrial Research or the Botanical Survey of India will issue further illustrations of Indian plants in volumes of 100 each so that all the regional floras can be illustrated. Considerable material may be found in Wight's and Icones published from time to time for reproductions. Already the Botanical Survey of India has rendered valuable service by republishing the major regional floras and it would be in fitness of things if they could also publish simple line drawing illustrations of Indian plants in suitable form. Such drawings can be often more reliable than lengthy descriptions or even photographs—particularly for depicting the structure of flowers and fruits.

It is necessary that many more regional and district floras should be available in order that the vegetation of most of our country may become better known to us.

P. V. B.

11. GRASSES AND GRASSLANDS. Edited by C. Barnard. pp. viii+269 (25·5×15·5 cm.). With 9 plates and many figures. London, 1964. Macmillan and Company Limited. Price 50*s*. or Rs. 40.

Australia is one of the leading countries in pasture research where the knowledge gained on temperate grasses and grassland is systematically applied for the development and management of subtropical and tropical grassland. A book which attempts to bring together accumulated knowledge on the subject as developed in Australia, would provide to research workers in the tropical countries an insight into the approach of Australian workers in solving grassland problems in subtropical and tropical environment. GRASSES AND GRASSLANDS edited by C. Barnard attempts to provide this accumulated knowledge and experience as developed by Division of Plant Industry of the CSIRO over the past thirty years, for the benefit of students and teachers and indeed for persons interested in the utilisation of pastures and their improvement. The various chapters have been contributed by eminent scientists.

The first chapter presents a picture of the historic development of grasses and grasslands in relation to the animals, which feed upon them. In chapter 2 the botanical classification and relationship of grasses are discussed whilst chapter 3 deals with their distribution, and chapter 4 their morphology and anatomy. Chapter 5 is concerned with the biology of the phenomenon of germination. This is followed by an essay on the quantitative analysis of growth in grasses and review in chapter 7, of knowledge on the relationships between their growth and environmental conditions. A comprehensive review of the nature of their reproductive mechanisms in chapter 8 leads to a discussion of their cytogenetics in chapter 9 in selection methods for species improvement in chapter 10.

Chapters 11-14 deal with the plant communities of grasses or grasslands, their evolution and distribution, nutrition and utilization in grazing and soil conservation.

A useful reference book for Indian workers engaged in research on grasses and grasslands.

P. M. D.
K. A. S.

12. THE OXFORD BOOK OF FLOWERLESS PLANTS. By F. H. Brightman and B. E. Nicholson. pp. viii+208 (25×18 cm.). With 688 colour illustrations. London, 1966. Oxford University Press. Price 45*s*.

This is a companion book to the OXFORD BOOK OF WILD FLOWERS and OXFORD BOOK OF GARDEN FLOWERS both illustrated by B. E. Nicholson. It amply fulfils its main purpose to enable the user to identify the common sea weeds, fungi, mosses, lichens and ferns found in British countryside.

The book contains 688 exquisite illustrations of these flowerless plants on 96 pages in full colour with relevant text on the opposite page. This makes the examination of the illustration very convenient. The irritation of turning pages is completely obviated. The text as well as the illustration indicate the habitat and habit of the plant quite clearly.

The flowerless plants are arranged under sea-shore, grasslands, uplands, wet places and woodlands. This is followed by the classification of the main groups of flowerless plants giving important characteristics of each group. In the contents, we also find the page numbers of these different groups of plants in various habitats. This again makes for a very easy reference, if necessary.

The last two topics are of much interest:—one gives the association between different flowerless plants in their natural habitat and the other gives a list of extra reading for those who may get further interested.

This book is one of the best examples of educative material for nature studies both for young and old. The production is superb and the illustrations are shown at their best. This publication, even though it pertains to Britain, is of such excellence that it deserves a place of pride in all good libraries and institutions teaching biology. Publications of similar excellence are badly needed in India to inculcate ideas of nature study and conservation.

P. V. B.

13. THE ROSE IN INDIA. By Dr. B. P. Pal. pp. xviii+265 (24·5×16 cm.). 44 coloured and 36 black and white plates and 18 figures. New Delhi, 1966. Indian Council for Agricultural Research. Price Rs. 36.50.

Dr. B. P. Pal, till recently the Director of the Indian Institute of Agricultural Research, is one of the most famous rose growers in India, and his garden in Delhi must have delighted many rose lovers for years. A book by him on roses in India was naturally eagerly awaited by all who grow roses or take an interest in flowers. While books on roses in Europe and America are numerous, and new ones are added as regularly as the new varieties produced by the famous breeders, there has been no important book about roses in India for many years. Meanwhile breeders have produced hundreds of new varieties, some with strikingly different colours, others with disease resistance, hardiness and freedom of flowering not known before. New methods for controlling pests or dealing with problem soils are also being discovered. The rose grower in India is eager to know which varieties are suitable for our conditions, and what pesticides can be used.

It must be stated here that Dr. Pal writes chiefly about rose growing in Delhi and in the north Indian plains. This undoubtedly is the best part of the country for roses, but there are other rose growing areas too, in fact they are grown all over the country. It seems a pity that while he does mention other rose growing centres like Bangalore and Poona (which has such an active and excellent Rose Society) he does not deal with their problems at all. Apart from this the subject is very completely covered including such matters as Roses in Legend, Art and Poetry, the making of rose products such as rose water and gulkand and flower arrangement. These subjects are only slightly touched upon, the main object of the book being to deal with the cultivation of roses, specially the two main types of bush roses, the Hybrid Teas and the Floribundas.

The other chapter heads in the book are: Classification; Planning the Rose Garden; How to select Varieties; How to plant and grow Roses; The feeding of Roses; Pruning; Propagation; Pests; Diseases; Rose breeding; Roses in pots; The Miniature Roses; Ramblers and climbers; The Shrub Garden; The standard Roses; How to exhibit; and finally a Select List of Varieties, and a glossary of technical terms which many will find very useful.

The chapter on classification includes short descriptions of wild roses native to India, which are not found in English and American books. The chapters on propagation, pests and diseases, and Rose breeding seem to me the best of all. Dr. Pal being a specialist in plant breeding has written an excellent chapter on that subject, and the two charts dealing with pests and diseases and their control will be found extremely useful by all growers.

There have been so many books on rose growing that it is almost impossible to add anything significantly new on matters such as feeding, propagation and pruning. Dr. Pal gives the manuring formula which has been worked out for Delhi and similar areas, and the Bangalore area. However rose growers in other parts of the country have been using other manures and fertilisers like Sterameal and fish etc. It would have been interesting to have Dr. Pal's comments on these methods. It is also unfortunate that even Dr. Pal is not able to give us any information about the various rootstocks in use in India. We seem to know very little about them. I find it again unfortunate that a rose grower of such eminence should have given almost no place and importance to his personal experience and observations in this book.

The book is profusely illustrated, and the black and white photographs all seem to me excellent, but several of the coloured photographs are rather disappointing. This is probably due to defective printing, but whatever the reason the colours are often far off the mark. Super Star for instance could be mistaken for Mojave and Montezuma looks like one of the old pink varieties with all the exciting orange coral shading gone out of it. Many will also regret the fact that a few photographs of the famous rose gardens of the world have not been included in the book. Dr. Pal has mentioned these, and photographs that appear in the Annuals of the Royal National Rose Society give an excellent idea of how roses are planted to best advantage. A whole chapter on the subject could not give one such a clear picture as a few photographs of these gardens.

If I mention a few shortcomings it must still be said that the rose grower and the rose lover in India will find this book excellent and full of scientific information.

A. J. A.

14. POISONOUS PLANTS OF INDIA. By R. N. Chopra, R. L. Badhwar and S. Ghosh. In 2 volumes (19×25 cm.). Vol. I revised and enlarged. pp. 632. 158 illustrations. Vol. II pp. 633-972. 99 illustrations. New Delhi, 1965. Indian Council of Agricultural Research. Price Vol. I Rs. 32·00, Vol II Rs. 20·50.

It is after a lapse of 16 years, since this book was first published in 1949 as an ICAR monograph, that this version, enlarged and revised, appears in two volumes. This is appropriate and timely for there has been of late a surge of world-wide interest in the study of plants as a potential source of drugs and chemical compounds of new constitution.

Both volumes are devoted to a detailed account of the plants which are reputed to produce poisoning in man and animals. A list of illustrations has been included in Volume I. This has been omitted in Volume II though the reviewer counted 99 illustrations in it.

The illustrations which are taken from numerous sources are well reproduced and easy to study even by one not specially trained in Botany (like the reviewer). Regarding botanical nomenclature, the recent accepted names of each of the plants described is given along with its English name and that in different Indian languages. The inclusion of older botanical names also is rather convenient for those who are more familiar with them. The etymology of the generic and specific names is explained in most of the instances—an interesting and educative sidelight.

The introduction is elaborate and incorporates a mass of heterogeneous information of a general nature, such as, the geographical distribution of poisonous plants, their constituents, diverse factors affecting their toxicity, their botanical classification and economic and therapeutic utility. The symptoms of poisoning with plants, their diagnosis and treatment have all been adequately dealt with. A particular attribute which the reviewer finds commendable is the tabulation of plants according to whether they produce dermatitis, or are poisonous to man and livestock, or possess insect-repellant properties or are toxic to fish. This could mean that a re-investigation of these plants or their related genera for active principles hitherto undiscovered or overlooked might be worthwhile.

Next the authors proceed to a description of individual plants arranged family-wise. Plants from ninety-three families are described each plant being discussed under four heads—botanical characters, distribution, uses and properties, and constituents. Considering the extensive coverage in both volumes and, therefore, the immense mass of literature the authors had to sift, it is not surprising that some omissions have occurred in places.

For instance, *Aquilegia vulgaris* is stated by the authors to be devoid of alkaloids. A recent paper by Winek *et al.* (*Journal of Pharmaceutical Sciences*, 1964, **53**: 734) has apparently been missed. The paper reports one alkaloid in *Aquilegia vulgaris*—a fact that may be accounted to better detection techniques or differences in soil, climate or other factors known to affect the alkaloidal content of plants.

In the reference to the family Magnoliaceae (p. 120) mention might have been made of alkaloids like magnoflorine and magnocurarine along with the other constituents.

Two of the most important alkaloids present in *Lochnera rosea* (p. 550) have unfortunately been overlooked. These are vinblastine and vincristine which have both been employed in the treatment of certain types of cancer in man—the former in Chorion Epithelioma and the latter in Acute Leukaemia in children. Among the constituents of *Lantana aculeata* (p. 699) lancamarone, a cardio-active steroid might have been also mentioned. Again, both *Girardinia heterophylla* and *Mucuna prurieus* which cause itching, redness and smarting of the skin are known to contain 5-Hydroxytryptamine (Serotonin) which is responsible for this effect. This fact has not been reported by the authors.

A distinct error has been committed in describing the pharmacological action of Atropine. The statements that the action of Atropine is due to 'a paralysis of all cholinergic (vagal) fibres' (p. 635) and that 'the pupil dilates because the endings of the oculomotor nerve in the sphincter of the iris are paralysed' (p. 636) are both wrong. According to the currently accepted view Atropine has no action on the nerve endings but combines reversibly with receptors on effector cells and prevents the molecules of Acetylcholive from exerting their normal action.

In conclusion, however, the usefulness of this publication as a valuable reference source outweighs the few shortcomings pointed out. The general get-up of both volumes is good and the price is moderate. Its addition to all libraries in research-oriented departments is strongly recommended.

S. R. A.

15. METHODS OF ANIMAL EXPERIMENTATION. Vol. I. Edited by William I. Gay. pp. xv+382 (23×15 cm.). New York, 1965. Academic Press Inc. Price $ 13·50.

This volume covers a number of general topics including methods of collecting body fluids, anaesthetic techniques, radiography, disposal of animals, care of germ free animals etc., and goes on to techniques of aerosol challenge, drug administration etc. The contents of volume II, which are listed show that it is intended to cover more complex procedures like ionizing radiation, tumour and organ transplants, parabiosis and also chapters on care and maintenance, exercise etc. of animals undergoing various types of experimentation.

In spite of what is implied in the preface, and the fact that some basic techniques are carefully described and illustrated, this is not a beginners' book. The information given is not comprehensive. The discussion of methods, the drawbacks or pitfalls which may arise, and the selection of topics are addressed to the experienced worker and may be more useful for the design and planning of experiments which require the use of advanced techniques rather than as a guide for the information of the technician in the laboratory. Hence some of the information given appears to be rather too elementary for such a work. The information given on special techniques is most useful since much of it would be unavailable without reference to numerous sources. Individual chapters are authoritatively written by persons who obviously have ample experience of the techniques they describe.

The book as a whole is a useful guide to the special methods and techniques discussed. It is not an instruction manual for the beginner. The printing and presentation, and the illustrations conform to the high standards which one associates with the Academic Press.

A. N. D. N.

Miscellaneous Notes

1. DOBSON'S LONG-TONGUED FRUIT BAT, *EONYCTERIS SPELAEA* (DOBSON), FROM KUMAON HILLS, U.P.: AN ADDITION TO THE CHIROPTERAN FAUNA OF INDIA

Dobson's long-tongued fruit bat, *Eonycteris spelaea* is the only species of the genus *Eonycteris* Dobson, 1873 recorded from Oriental region. It was first recorded from Farm Caves at Moulmein, Burma by Dobson (1871) (cited by Blanford 1891). The distribution range of the species includes Burma, Thailand, Laos, Vietnam, Cambodia, Malaysia, Indonesia and Philippines (Blanford 1891; Ellerman & Morrison-Scott 1951). It has not so far been recorded from India and the records cited below are new for the country.

During a recent tour of the Kumaon Hills, U.P. in connection with a survey of haematophagous arthropods, 4 males and 3 females of a bat species identified as *Eonycteris spelaea* were trapped in Japanese mist nets. Skins of 3 males and 1 female and skulls of 2 males and 1 female were preserved for confirmation of the identification. The identification was confirmed at the Bombay Natural History Society, by comparing with the authentically identified material of the species. Dr. G. Topal of the Hungarian Natural History Museum, visiting scientist at the Bombay Natural History Society, kindly helped in confirming the identity of the species. Many thanks are due to him.

All the specimens were trapped in mist nets set up near banana plantations. Detailed collection data are as follows: 2 males from Dugada, Naini Tal District, on 25 February 1967, skins of both and skull of one specimen preserved; 1 male and 1 female from Dharchula, Pithoragarh District, on 17 and 18 March 1967 respectively, skin of the male preserved; 1 male, 1 juvenile female from Kotera, near Dharchula, Pithoragarh District, on 19 March 1967, skull of the male preserved; and 1 pregnant female from Aatkhet near Thal, Pithoragarh District, on 30 March 1967, skin and skull preserved.

Average measurements in millimetres, taken from preserved skin and skulls mentioned above are as follows:

	♂	♀
Head and body ..	126	123
Tail ..	8·6	8
Ear from orifice ..	16·5	16
Forearm ..	69·0	67
Total length of skull ..	35·25	34
Zygomatic breadth ..	20·5	20

VIRUS RESEARCH CENTRE,[1]
POONA,
August 17, 1967.

H. R. BHAT

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2. OCCURRENCE OF THE BROWN BEAR, *URSUS ARCTOS* LINNAEUS, IN BHUTAN

On being asked if the Brown Bear, as opposed to the Himalayan Black Bear, was found in Bhutan, the King of that country recently informed me that he himself shot a Brown Bear in northern Bhutan north of Bumthang in 1945. The skin was not available for examining or photographing, but I see no reason to disbelieve the source of my information as there could surely be no confusion by an experienced sportsman between the Brown Bear and the Himalayan Black Bear.

The range of the Brown Bear is given by Ellerman & Morrison-Scott's CHECKLIST as Kashmir and Punjab (now Himachal Pradesh) so far as the Indian subcontinent is concerned, and by Prater's BOOK OF INDIAN ANIMALS as 'the north-western and central Himalayas'. It may now be accepted that the Brown Bear has been recorded from Bhutan on one occasion.

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[1] The Virus Research Centre is jointly maintained by the Indian Council of Medical Research and The Rockefeller Foundation. The Centre also receives a grant (3×4307) of PL 480 Funds from the National Institutes of Health, USPHS, through the Indian Council of Medical Research.

EVERGREEN COTTAGE,
SHILLONG 5,
ASSAM,
June 4, 1967.

E. P. GEE

3. OCCURRENCE OF THE DESERT CAT, *FELIS LIBYCA ORNATA* GRAY NEAR POONA

While engaged in local (40 kilometre radius around Poona) intensive survey programme of the Western Regional Station at Poona, during the year 1966-67, I collected two specimens of the Desert Cat from Shira, near Kamshet (Bombay-Poona Road), on May 22, 1966 and February 12, 1967. It is gathered from the existing records (Ellerman & Morrison-Scott 1951; Prater 1965) that this species is known to occur only in the drier regions of north-western, western and central India, approximately 80° E. in the east and to 22° N. in the south. It has never been reported to occur so far down south as Poona (18° 30′ N.).

WESTERN REGIONAL STATION,
ZOOLOGICAL SURVEY OF INDIA,
1182/2, F. C. ROAD,
POONA-5,
August 29, 1967.

B. S. LAMBA

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PRATER, S. H. (1965): The Book of Indian Animals. Bombay Natural History Society, Bombay.

4. OCCURRENCE OF THE SNOW LEOPARD, *PANTHERA UNCIA* (SCHREBER), IN BHUTAN

In Ellerman & Morrison-Scott's CHECKLIST OF PALAEARCTIC AND INDIAN MAMMALS the range of the Snow Leopard is given as only Kashmir, as far as the Indian subcontinent is concerned. In Prater's BOOK OF INDIAN ANIMALS it is given as 'In India . . along the whole

Himalayan chain from Kashmir to Sikkim. Northwards . .' I can find no mention of Bhutan being given as part of the range of this creature.

But on two recent visits to Bhutan I have personally seen no less than four skins of Snow Leopard, all of which were killed in Bhutan and were in the possession of the King, who has kindly pointed out to me on the map the places in Bhutan they were obtained. Evidently they occur all along the northern part of Bhutan, and they sometimes descend to quite low elevations—an animal shot as low as 9,000 feet was very dark and a colour photograph of this skin was shown to the British Museum of Natural History who identified it as 'undoubtedly that of a Snow Leopard'.

The other three skins, were of the normal white background colour. Books on mammals, therefore, need to be amended accordingly in order to include Bhutan in the range of the Snow Leopard.

EVERGREEN COTTAGE,
SHILLONG-5,
ASSAM,
June 4, 1967.

E. P. GEE

5. OCCURRENCE OF THE NAYAN OR GREAT TIBETAN SHEEP, *OVIS AMMON HODGSONI* BLYTH, IN BHUTAN

In Ellerman & Morrison-Scott's CHECKLIST the range of this wild sheep is given as 'Tibet, probably on Nepal frontier', Himalayan region', 'Nepal', 'Tibet' and 'Ladak'. In Prater's BOOK OF INDIAN ANIMALS it is given as 'The plateau of Tibet from northern Ladak eastwards . . . the extreme north of Sikkim'. No mention of Bhutan is made in either of the above two books.

I recently learned from the King of Bhutan that this sheep is in fact found in Bhutan, in the extreme north of the Ha and Paro valleys near the Tibetan border. He himself shot one north of Paro in 1945, and kindly allowed me to photograph the head as documentary evidence. Patrols in the area report each year the continued existence of these sheep, and within the last year similar reports have come in about their survival. They are strictly protected, I was informed, and not allowed to be shot by anyone. Books on mammals need to be amended accordingly.

EVERGREEN COTTAGE,
SHILLONG-5,
ASSAM,
June 4, 1967.

E. P. GEE

6. A CASE OF ALBINISM IN *RATTUS BLANFORDI* (THOMAS), 1881 (RODENTIA : MURINAE)

Since 1961 regular trapping of rodents and shrews formed part of the work of the Virus Research Centre Field Station at Sagar (Shimoga District, Mysore State) which was engaged in the studies on the epidemiology of Kyasanur Forest Disease. Blanford's Rat, *Rattus blanfordi* was consistently obtained in 'Sherman' traps throughout the year. The total number of rats of this species collected since 1961 were as follows:

1961	174
1962	232
1963	284
1964	150
1965	166
1966	207

Total : 1213 rats in 1,14, 184 trap nights.

All the 1213 rats obtained during this period were typical *Rattus blanfordi* with the normal coloration as mentioned by Ellerman (1961)[1].

On 17 November 1966, an albino female rat was captured in an evergreen patch of forest about four miles south of Sagar. This was provisionally identified as *Rattus blanfordi* from the type of noise it made. Unlike normal *blanfordi* specimens, the fur was uniformly dull white in colour with pink eyes. The tail was also uniformly dull white in colour, whereas in normal rats, the tail is dark brown basally and whitish terminally. The measurements of this albino rat were as follows: head and body 188 mm., tail 203 mm., hind foot 35 mm., and ear 31 mm. The identification has been confirmed by breeding experiments in the laboratory.

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[1] Ellerman, J. R. (1961): Fauna of India, Mammalia 3. Zoological Survey of India, Calcutta.

This is the first time an albino rat of this species has been encountered during our studies and there are no published records of an albino of *Rattus blanfordi.* In the laboratory, several attempts were made to breed wild caught *Rattus blanfordi* and these were unsuccessful because of the failure of the wild caught female to accept a male in captivity. No mating could be achieved even after changing the partners. Since albinism carries with it the trait of tameness, a normal male was provided in the cage containing the albino female. Mating was observed in captivity and the albino female delivered three normal coloured young ones after a gestation period of 25-26 days. The albino female was again provided with a normal male after the babies were weaned, and another two normal coloured young ones were delivered after a gestation period of 26 days.

The albino female and the young ones are kept alive at Sagar Field Station for further observation and breeding experiments.

VIRUS RESEARCH CENTRE,[1]
POONA,
September 4, 1967.

P. K. RAJAGOPALAN

7. REDNECKED GREBE *PODICEPS GRISEIGENA* (BODDAERT) SIGHTED IN WEST PAKISTAN

(*With a plate*)

On January 14, 1967, whilst working on the International Wildfowl Census at Lal Suhanra, the writers had a clear view of a bird which was identified as *Podiceps griseigena.* Since this species is not listed by Ripley (1961) or by Stuart Baker (1929) it is believed that this may constitute a new record for the subcontinent.

Lal Suhanra (29° 31′ N., 71° 55′ E.) situated approximately 16 miles east of Bahawalpur City in West Pakistan, comprises a chain of tamarisk-studded jheels covering an area of some 10 square miles where surplus canal water is stored in summer. Food supplies for diving birds were apparently abundant as evidenced by the numbers of diving duck (including Smew), cormorants and darters wherever areas of open water occurred.

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[1] The Virus Research Centre is jointly maintained by the Indian Council of Medical Research and The Rockefeller Foundation. The Centre also receives a grant (3×4307) of PL 480 Funds from the National Institutes of Health, USPHS, through the Indian Council of Medical Research.

The bird was sighted at a distance of about 200 yards, and studied through 20×70 binoculars and telescopes ×60 mounted on tripods, at 1.30 p.m. in bright daylight and with the sun behind. It was realised at once that it was too small to be a Great Crested Grebe and at the same time too large and long in the neck to be a Black-necked Grebe *Podiceps caspicus*, both species with which we were familiar. A solitary Great Crested Grebe *Podiceps cristatus* had been watched on an adjacent strip of open water and moreover a nearby group of about 40 Little Grebes *Podiceps ruficollis* provided ample size comparison.

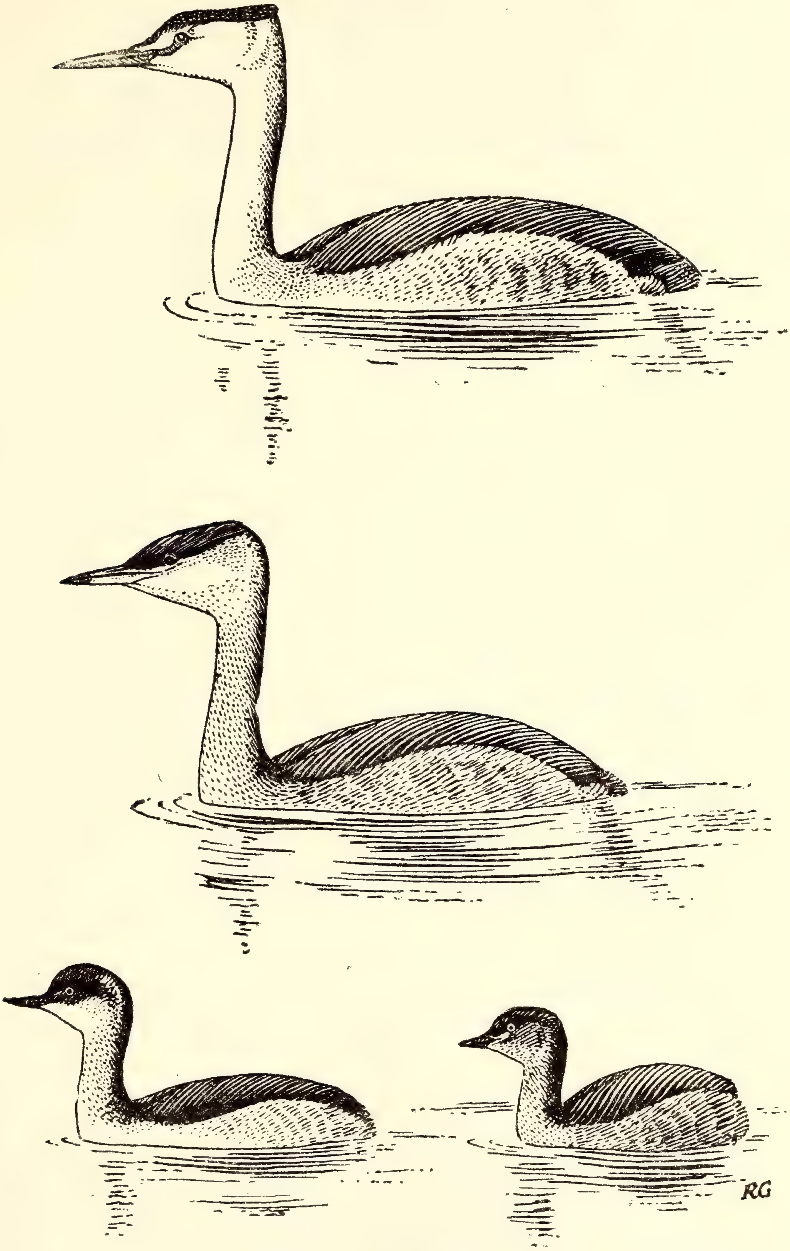
When the bird was scrutinised minutely, it was noted that the crown down to the level of the bill and eye was dark in colour, whereas the Great Crested Grebe had clearly shown white above the eye and bill. The sides of the head and cheeks showed white in a wedge-shaped pattern outlined by the dark grey of the hind neck. The rest of the neck was grey in colour, which also served to emphasize the former character.

Peterson (1966) was consulted at the time, from which the writers were convinced that this bird could only have been a Rednecked Grebe *Podiceps griseigena* in winter plumage. It should be added that one of the writers (T.J.R.) is familiar with this species in British Colombia.

Having only a 12-bore shotgun and no means of getting closer to the bird, there was no question of securing it, but in view of the circumstances it is believed that this sighting is worthy of record.

The recorded distribution of *Podiceps griseigena* is shown in map form by Dementiev & Gladkov (1951), and the breeding distribution also by Voous (1960). It has a discontinuous Holarctic breeding distribution—being absent in central Siberia—and winters in the coastal regions of the United States, China, the Mediterranean and southern Caspian. Of particular interest to the subcontinent are the breeding grounds of Kazakhastan. Of these Dolgushin (1960) mentions in particular the Syr Darya delta and the Balkhash basin, but adds that information on the species has recently greatly improved and it seems that the species is much more widespread than formerly supposed. The winter quarters of these Kazakhastan birds are as yet unrecorded—there is only one record of the species being found in Kazakhastan in winter. He mentions however that the species has been found 'in the mountains' on spring passage.

J. Bombay nat. Hist. Soc. **64** (3)
Holmes: Rednecked Grebe



Great Crested Grebe

Rednecked Grebe

Blacknecked Grebe

Little Grebe

Two forms occur in Kazakhastan, the European or nominate race *P. g. griseigena* and a markedly larger race found in the Balkhash basin *P. g. balchaschensis* Korelov (Dolgushin 1960). The latter appears to be similar in size to the eastern form known as *P. g. holboelli* (Reinhardt) (Dementiev & Gladkov 1951). It is noteworthy that the Balkhash form has wing measurements comparable with the Great Crested Grebe *Podiceps cristatus* while its weight is only half that of this species.

In the circumstances it seems surprising that the Rednecked Grebe has not been recorded earlier in the subcontinent and we hope that this note may stimulate closer scrutiny of any large grebe seen in the subcontinent.

WILDFOWL SURVEY,
C/O 11-F GULBERG,
POST BAG 704,
LAHORE,
WEST PAKISTAN,
January 31, 1967.

J. R. S. HOLMES
T. J. ROBERTS
C. D. W. SAVAGE

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8. UNUSUAL METHOD OF FISHING BY LITTLE EGRET *EGRETTA GARZETTA* LINNAEUS

On Sunday 4 June 1967, I was at Powai Lake, Salsette, Bombay (with my wife and children), when far out in the distance we saw a couple of egrets behaving in a curious manner. They were not far apart and at first sight it looked as if they were hesitating before 'landing' on the water—perhaps not being sure how deep it was. However, they did not settle, and flew towards us close over the water. As they came near it was apparent that this low flying disturbed large numbers of small fish (*Cheia* sp.) which skimmed ahead over the water. The egrets, now recognised as the Little Egret (*Egretta garzetta*) had their necks extended and the 'undercarriage' (legs and feet) half-way down. We did not actually see them catch a fish but they were no doubt interested in them. The flight was over 400-500 yards. I do not remember having seen or read of an egret or heron fishing in this manner.

The level of the water in the lake was exceptionally low and the anglers were having a field day. Our boat was preceded by a continuous stream of 2-3 inch *Chela* sp., jumping out and skimming along the surface, while an occasional Rohu (*Labeo rohita*) jumped high. A 1-lb Rohu and many *Chela* jumped into the boat.

A week later (11 June) we were there again and saw six or seven Little Egrets regularly fishing in the manner described earlier. This time however, they kept their necks half-drawn in, enabling them to jab at and catch the fish. They flew around in wide circles, often two or three together and appeared to be catching quite a few fish. Two larger egrets (probably *Egretta alba*) and a Grey Heron (*Ardea cinerea*) stayed on the shore and continued to fish in the normal heron/egret style.

FAIZ & CO.,
75, ABDUL REHMAN STREET,
BOMBAY,
June 15, 1967.

HUMAYUN ABDULALI

9. THE WHISTLING TEAL [*DENDROCYGNA JAVANICA* (HORSFIELD)] IN THE CALCUTTA ENVIRONS

Recent notes on the Whistling Teal [*Dendrocygna javanica* (Horsfield)] around Calcutta remind me of the large numbers that it was possible to see in every village pond of any size when I was a student at Shantiniketan and at Calcutta (1914-1924). On the larger pieces of water, flocks of a couple of hundred birds were not uncommon and I must admit that we used to shoot them all the year round. The breeding season must have been about the middle of the rainy season, for from the end of July onwards I saw young ducklings through August to November. I never saw a nest on water and thought that the favourite place was the Screw-Pine or *Keora*, the culms of which used to be found along water-courses and nullahs all over Bengal. The plant is armed with formidable thorns. I remember a teal flying out of the bush of a Screw-Pine which I was trying to climb for the flowers. The teal flew in a laboured manner for a short distance and then flopped down in a paddy field about 50 feet from me, where it remained flapping its wings. I thought it was an injured bird and the prospect of teal curry prompted me towards it. When I got within a few feet, it rose in laboured flight and flying a short distance flopped down again. I tried to catch it again and it behaved similarly taking me further and further away from the Screw-Pine. It was after a considerable time that it dawned upon me that the teal was drawing me away and the nest was probably in the bush. However by now we had moved far away and it was time to go back to Shantiniketan.

On another occasion I saw from the bank of a small pond a Whistling Teal settle on the open water. From its back 5 or 6 ducklings tumbled into the water after the parent settled.

The birds from the zoo pass over where I stay and large flights may be seen and heard during the cold weather. From early April their numbers appear to diminish, and only small flights of 5 or 10 are seen. Except for the first record of one pair nesting in the rhinoceros paddock (H. A. Fooks; *J. Bombay. nat. Hist. Soc.* 1966, **63**: 200) these birds do not nest in the Zoo Gardens, and their dispersal during the breeding season is no doubt responsible for the change in numbers.

10, PARK MANSION,
CALCUTTA-6,
June 1, 1967.

B. BASU

10. ON THE OCCURRENCE OF THE FULVOUSBREASTED WOODPECKER *DENDROCOPOS MACEI* (VIEILLOT) IN SIKKIM

Dr. Sálim Ali in THE BIRDS OF SIKKIM says (p. 97) 'The Fulvous-breasted Woodpecker *Dendrocopos macei macei* (Vieillot), was not met with in Sikkim by the Survey, and apparently neither by Schäfer. According to Stevens it occurs in the Rungbong Valley up to *c*. 3500 ft., and has been obtained in the Teesta Valley at *c*. 2400 ft.' This note is to record that there is a female *Dendrocopos macei* (Vieillot) collected by Dr. B. Biswas near Pechreck, 6 km. east of Dentam, Kalet Valley, Sikkim (*c*. 1400 m.), on 1 Jan. 1953 in the Zoological Survey of India Reserve Collection (Coll. No. BSM. 116).

Measurements of the specimen are as follows:

Wing 112 mm., Tail 62 mm., Bill (from skull joint) 25·5 mm.

Bombay Natural History Society,
Hornbill House,
Bombay, 1-BR,
May 11, 1965.

P. V. GEORGE[1]

Reference

Ali, Sálim. (1962): The Birds of Sikkim. Oxford University Press.

11. THE JUNGLE CROW, *CORVUS MACRORHYNCHOS* WAGLER, A DETERMINATE LAYER

During the past couple of years, I have conducted a number of experiments at Poona, in order to ascertain whether or not *Corvus macrorhynchos* Wagler is a determinate layer.

In five nests I added 4 eggs (5 being the largest normal number) each after the first egg was laid. In three of these nests, 3 eggs were laid at intervals of twenty-four hours in spite of the addition; in one 2 eggs, and in the fifth nest 4.

In seven nests the first two eggs laid were removed. In four of these nests 2 more eggs were laid, in two 1 more, and in the last nest 3 more (2 to 5 being the normal clutch).

A clutch of four artificial eggs when placed in a freshly completed empty nest was accepted by the apparently surprised female, who, however, started sitting on it and added to the dummy clutch its own full clutch of four eggs, commencing from the next day.

These experiments conclusively prove that the Jungle Crow neither lays additional eggs to complete a clutch if a part of it is removed nor stops laying if more eggs are added to the incomplete clutch. It is therefore a determinate layer contrary to my previous assumption (Lamba, 1965 : 428).

Zoological Survey of India,
Western Regional Station,
1182/2, F. C. Road,
Poona-5,
July 11, 1967.

B. S. LAMBA

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[1] Present Address: Curator of Birds, Iraq Natural History Museum, Waziriya, Baghdad, Iraq.

REFERENCE

LAMBA, B. S. (1965): Nidification of some Common Indian birds.—2. The Jungle Crow, *Corvus macrorhynchos* Wagler. *J. Bombay nat. Hist. Soc.* **62**: 425-433.

12. THE BROWN DIPPER (*CINCLUS PALLASSI*) AS A HOST OF A CUCKOO (*CUCULUS* SP.)

On 16 May at Kokernag Springs in the Bringhi Valley, Kashmir, I saw a Brown Dipper (*Cinclus pallassi*) in flight being followed by a cuckoo (*Cuculus* sp.). They both then alighted on a rock, and the dipper was seen diving, coming up and feeding the cuckoo. The identity of the cuckoo could not be definitely determined, due to the fact that it was juvenile, but a yellow bill was noted.

The only previous record I could trace of a dipper fostering a cuckoo was that of Stuart Baker (1942, CUCKOO PROBLEMS: 186), who had taken an egg of the Khasia Hills Cuckoo (*Cuculus canorus bakeri*) from the nest of a Brown Dipper of a different race to that found in Kashmir.

A record of another bird of the torrents being parasitized by a cuckoo is that of Mr. W. T. Loke (*J. Bombay nat. Hist. Soc.* **50**: 658) who recorded and published a photograph of the Plumbeous Redstart (*Rhyacornis f. fuliginosus*) feeding a Cuckoo (*Cuculus canorus*) at Sonamarg, Kashmir.

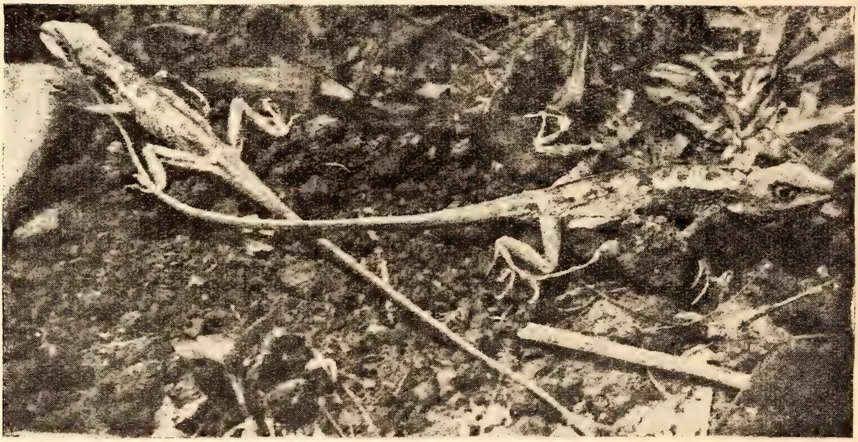
33, PALI HILL,
BANDRA,
BOMBAY 50-AS,
May 24, 1967.

RAUF ALI

13. NOTES ON THE AGAMID LIZARD *PTYCTOLAEMUS GULARIS* (PETERS) FROM KHASI HILLS, ASSAM

(*With a photograph*)

As stated by Wall (1907) *Ptyctolaemus gularis* is not uncommon in the Shillong area. An olive-brown lizard it is easily distinguished by the three longitudinal folds on each side of the middle of the throat, which curve and converge backwards, forming a U-shaped figure, deep blue in life and blackish in preserved specimens. There are five broad transverse bands on the body and a number of them on the head and on the tail. In life there is a green dorso-lateral band in the anterior portion of the body (Photo). The lateral surface of the anterior half of the body below the green band is marked with a net work of dark brown, enclosing oval or elliptical green patches.



Ptyctolaemus gularis (Peters)

These are arboreal lizards living in urban areas as well as in the forest. The coloration is cryptic, particularly when on pine trunks. They are diurnal and are often seen basking in the sun. When approached they usually try to hide, seldom running away but often jump from the tree remaining motionless thereafter, and thus are easily caught.

When excited they distend their gular pouch which is expanded vertically. In the normal condition the pouch is folded back when the skin gives rise to the three longitudinal lines on each side of the throat, characteristic of the species. This species is available in Shillong and its adjacent areas from the end of March to the beginning of November when it hibernates for the cold season. In December 1964, I obtained one specimen under earth in a forest on the bank of the Myntru River while working out a dead tree trunk for arthropods and molluscs.

Food and feeding habits. The lizard feeds on insects, spiders and other soil arthropods for which they often come down to the ground. Examination of faecal matter and stomach contents revealed examples of different insect orders including Lepidoptera, Diptera, Orthoptera and a few Hemiptera. When the lizard was fed in the laboratory with butterflies, (*Pieris* sp.) a large number of undigested scales were observed; chitinous remains of head, legs, mouth parts, and wings were also noticed. The faecal matter, consists exclusively of chitinous remnants of insects, spiders and other arthropods.

Breeding season. From the middle of May they are seen in pairs. This is an oviparous species and lays 14 to 15 eggs. From a gravid female fifteen eggs at different developmental stages were collected; five of these eggs were well developed and almost equal in size, the rest were successively smaller. They are whitish in colour and elongated and measure 12·50 mm. in length and 7·00 mm. in width. Very young specimens are seen from the end of August.

ACKNOWLEDGEMENT

I am grateful to Dr. B. K. Tikader, Officer-in-Charge, Eastern Regional Station, Zoological Survey of India, for constant encouragement and facilities for work.

ZOOLOGICAL SURVEY OF INDIA,
EASTERN REGIONAL STATION,
SHILLONG-4, ASSAM,
June 12, 1967.

S. BISWAS

REFERENCE

WALL, F. A. (1907): Remarks on the Agamid lizard *Ptyctolaemus gularis*. *J. Bombay nat. Hist. Soc.* **18**: 505.

14. MATING AND OTHER OBSERVATIONS ON SEA SNAKES IN CAPTIVITY

(*With a plate*)

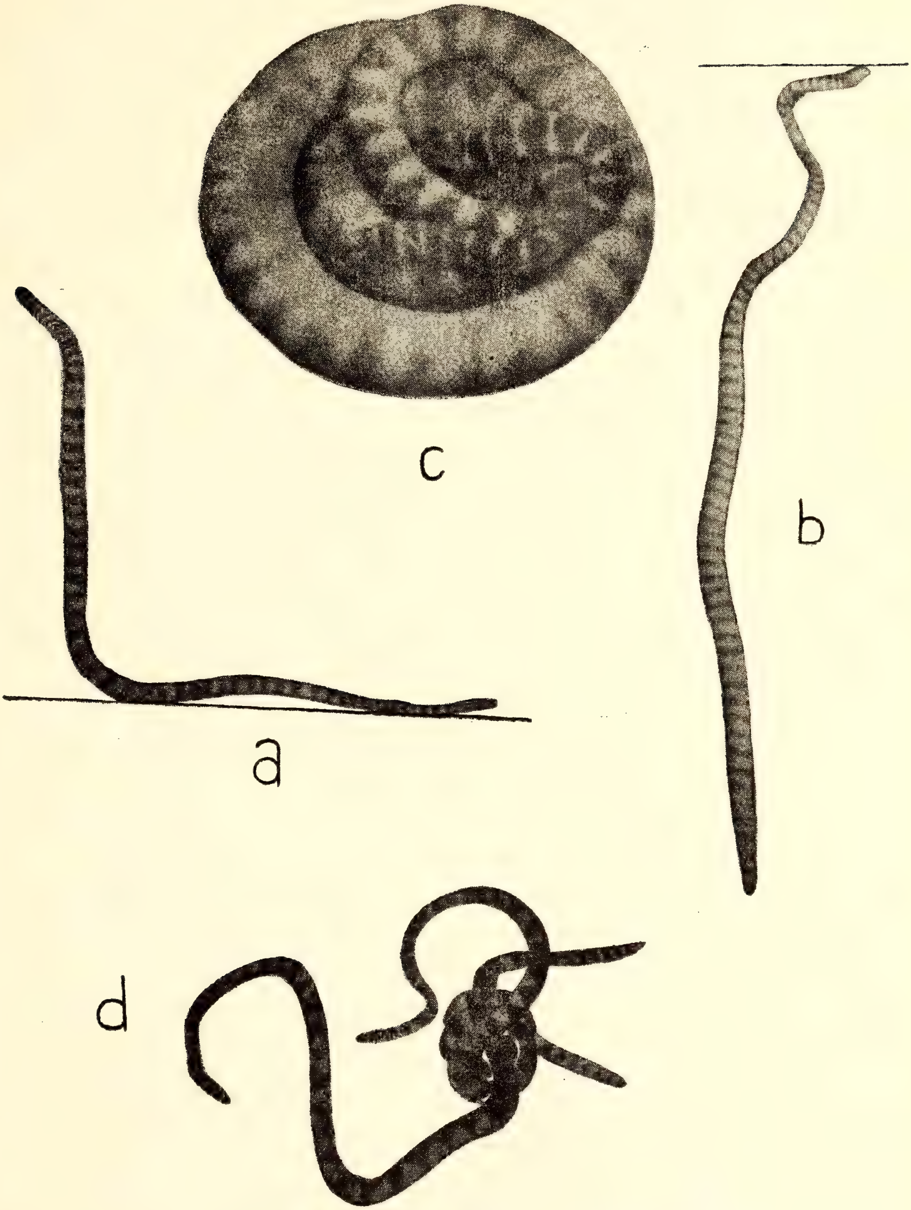
Death posture of a sea snake has, so far, not been recorded; probably the non-availability of a specimen at death, either from the natural environment or in captivity has precluded such an observation. At the Taraporevala Aquarium, Bombay, sea snakes (mainly *Hydrophis cyanocinctus*) have been kept on display for over 15 years. In nature, they are known to feed on marine eels (*Sodonophis boro*) and *Trypauchen vagina*, this having been ascertained by examining the stomach contents. In captivity, however, they rarely accept food, and starvation leads to their death within a few months of their capture. Lying dead in their tank, they are invariably found curled up on the bottom like a watchspring, with the head near the centre of the coils (plate, *c*).

Whether the same posture is assumed in nature is not known, since their behaviour in captivity may not be the same as that in nature. Thus, it has been observed that sea snakes, when basking on the sea surface, float with their whole body horizontal. In the display tanks, however, two positions are normally seen. In one, the anterior half of the body is on the floor, and the posterior half remains rigidly vertical, with the tail looped in the shape of a shepherd's crook (plate, *a*). Or the head and some part of the body may skim the surface, and the rest of the body hang limply down (plate, *b*).

Copulation in sea snakes has been reported only once, to our knowledge (1926: Poyntz, A. R., *J. Bombay nat. Hist. Soc.* **31**: 1038-1039), where too, the species has not been mentioned. On the 19th November, 1966, we had the opportunity to see a pair of sea snakes, *Enhydrina schistosa*, copulating in one of the display tanks at the Aquarium. The male had twisted the hind portion of its body tightly around that of the female, making two and a half turns of its body in tight coils around the female. The tails as well as the anterior portion of the body were quite separate. The region around the vent in the female had become quite turgid, and fishes (*Caranx* sp.) kept in the tank frequently nibbled at the skin in this region. This, however, did not disturb the snakes in the least, which lay on the bottom of the tank in the position indicated in the sketch (plate, *d*). From time to time both the snakes simultaneously rose slowly up to the surface of the water for a breath of air. Copulation was first observed at 12.30 p.m., and the snakes were seen to have separated by 7.30 p.m. the same day.

TARAPOREVALA MARINE BIOLOGICAL STATION,
BOMBAY,
July 6, 1967.

B. F. CHHAPGAR
H. G. KEWALRAMANI



Resting and other habits of sea snakes

(*a*) Position of sea snake resting on bottom of display tank ; the tail is normally looped over more than in the photograph, being shaped like an interrogation mark ; (*b*) Position of sea snake resting at the water surface of display tank ; (*c*) Position of sea snake on death ; (*d*) Position of mating sea snakes.

15. THE STATUS OF THE CEYLON FROG *RHACOPHORUS NASUTUS* (GUNTHER)

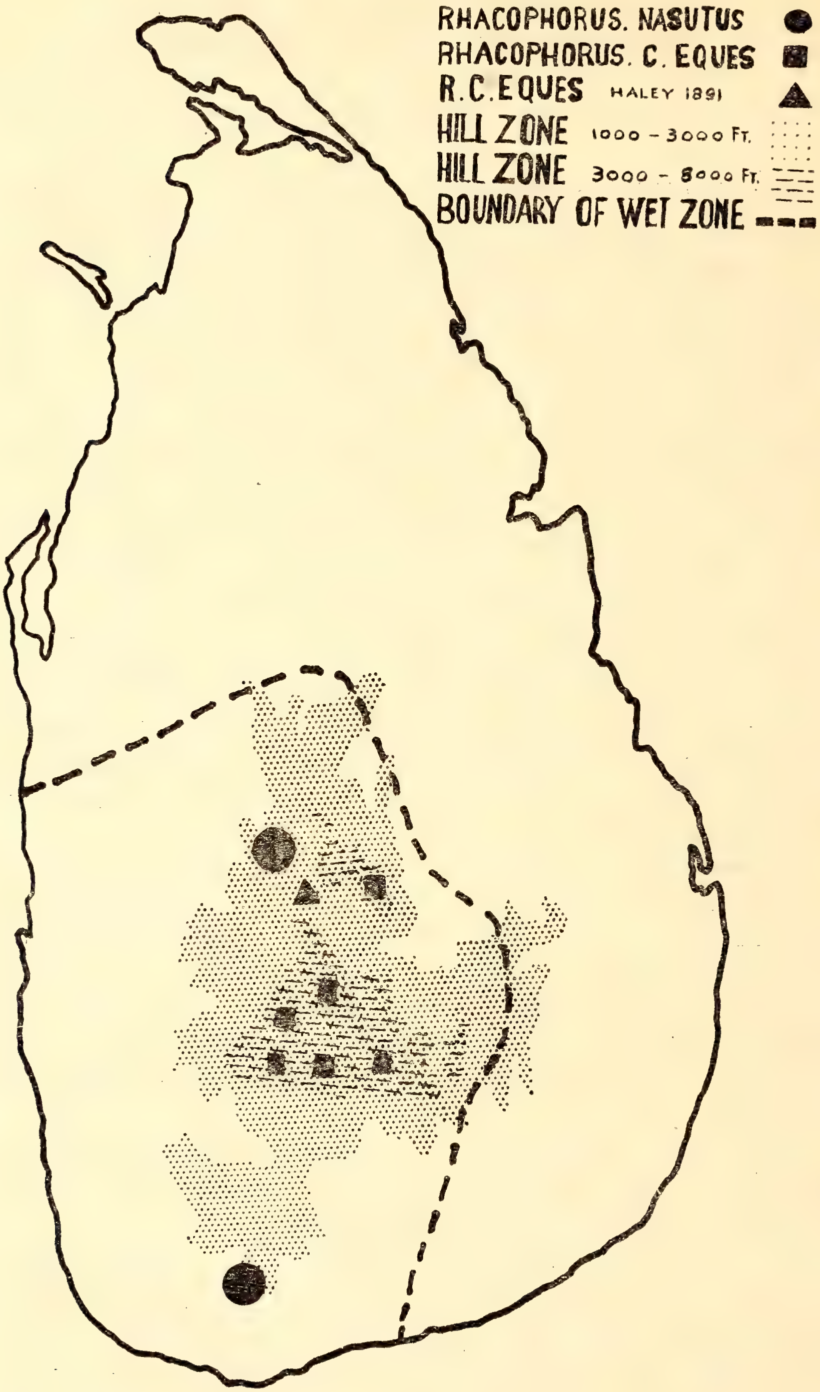
(*With a map*)

The description of *Rhacophorus nasutus* was based on a single, adult female specimen whose origin was stated as south Ceylon. In 1871 a second specimen, also an adult female without precise locality data was discovered. Both these specimens were deposited in the collection of the British Museum. From 1868, until Wolf (1936) undertook his revision of the genus *Rhacophorus*, *R. nasutus* was considered a valid species. Wolf, without any conclusive reasons regarded *R. nasutus* as a variant of *R. eques* Gunther, and tentatively placed it within the synonymy of the latter. De Silva (1955) apparently accepted Wolf's demotion of *R. nasutus*, as he makes no mention of the species in his paper. In 1957 Kirtisinghe reduced *eques* to subspecific rank and included *nasutus* in the synonymy of his *R. cruciger eques*. Although the type and one other example of *nasutus* were available to Kirtisinghe he apparently believed that the points of difference between *nasutus* and *eques* were too insignificant to justify *nasutus* as a distinct form. As he probably had no evidence of the ecology nor of the geographical distribution of *nasutus*, it is perhaps understandable that he hesitated to resurrect *nasutus*. His description of *eques*, however, takes no account of the features or coloration of *nasutus*.

Recently (1964, 1965, 1967) the author and Mr. V. Athukorale obtained eight adult males from the lower Matale area and from the Kanneliya forest area, both localities within an ecological zone different to that within which *eques* is known to occur. A comparison with the British Museum material of *nasutus* and *eques* leaves no doubt as to the distinctiveness of *R. nasutus* which can be readily distinguished from *eques* on colour pattern, proportions and snout shape.

Both species seem to inhabit the wet zone of Ceylon which was defined by Cooray (1948) as having an effective rainfall through all months of the year and over 90 inches annually.

The zone of *R. c. eques* is confined to the Central Hills at an elevation of over 2,500 feet, and all records, i.e., Elkaduwa, Wattegama, Lindulla, De Silva (1955); Nuwara Eliya, Uda Pusellava, Diyatalawa, Haggalla, and Nau Oya, Kirtisinghe (1957); are at elevations of over 3,000 feet. Haley (1891) records it from Kandy,


RHACOPHORUS. NASUTUS
RHACOPHORUS. C. EQUES
R.C.EQUES HALEY 1891
HILL ZONE 1000 - 3000 FT.
HILL ZONE 3000 - 8000 FT.
BOUNDARY OF WET ZONE

Map showing the recorded distribution of *R. nasutus* and *R. c. eques* though Kandy does lie within the Central Hills and possibility of a straggler from the surrounding hills does exist, the low elevation of this area 1000 feet, above m.s.l. leaves this record open to doubt.

The specimens examined indicate that *R. nasutus* lives at a lower level than *R. c. eques*, its range seems to be in the western and southern part of the low wet hills of the second/third peneplin which surround the central hill zone and has so far been recorded from elevations below 1,500 feet.

Rhacophorus nasutus (Gunther)

Polypedates nasutus Gunther 1868, p. 486, p. 39, fig. 2.
Rhacophorus nasutus Boulenger 1882, p. 85 and 1890, p. 476.

Material examined: Adult ♀ Holotype, 68·5·13·16; 1947·2·8·61 from the south of Ceylon; Adult ♀ B. M. 71·12·14·37 from the south of Ceylon; Eight adult ♂♂ from Lower Matale and Kanneliya Forests, Ceylon.

Diagnosis

Small to medium sized frogs similar to *R. eques* both in size and habits, but differing from this species by possessing a more elongate snout terminating in a pointed dermal flap. The ratio of snout to inter-orbital distance ranging from 1·84 to 1·90 while it is 1·18 to 1·24 in *R. eques.* The pigmentation under the throat in both males and females of *R. nasutus* form a regular pattern which is absent in *eques.*

Description

Habit slender, snout long and narrow, terminating in a very sharp point formed by a dermal flap similar to the 'spurs' on its heels. Nares open laterally, their distance from the tip of the snout about half their distance from the anterior border of the eye. Canthus rostralis curved, loreal region oblique, the snout in profile projects well beyond the lower jaw. The distance from the tip of the snout to the anterior border of the eye is about twice the width of the eyelid. The tympanum is half the distance from the nares to anterior border of the eye. Choanae elliptical, vomerine teeth never projecting beyond the level of the posterior border of choanae. Tibio-tarsal articulation of the adpressed hind limb reaches the tip of the snout or between nostril and snout tip.

Fingers not webbed, disks of the fingers are large, diameter of disks of the 3rd finger equal to distance from tip of snout to nares.

The toes are about half webbed. The free phalanges on each toe being as follows:—

1st	2nd		3rd		4th		5th
	Int	Ext	Int	Ext	Int	Ext	
1½	2	1½	2	1½	2¾	2¾	1½

The heel bears a dermal flap which is pink to red in life, a small inner metatarsal tubercle is present and is equal in size to the subarticular tubercle under the first toe.

Skin smooth above with a narrow glandular fold which runs from behind the eye, above the tympanum to the shoulder. Ventrally the skin is smooth on the throat but finely granular on the belly. The lower sides of the thighs bear large whitish tubercles, those below the anus, usually a series of four or five, being the largest.

The ground colour in life varies from an olive-green to grey above broken by a band of brown sometimes edged with pink which passes from the tip of the snout, bifurcates over the snout, above the eyes passes over each eyelid to run parallel to each other along the body. A fine, dark, median line is usually present between these bands. A chocolate black band bordered above by the dorso-lateral fold runs from tympanum to the flanks, below this dark band there is a prominent white band which runs from below the eye to the groin; occasionally a longitudinal row of small dark spots is present above the dorso-lateral fold. Lower parts a uniform yellow; throat pattern comprising of median streak or twin lines which usually extend from the edge of the lip to the thoracic region; on each side of this dark streak a long series of ocelli or streaks. Lower lips dark. On ventral surface close to the axillae a dark oval blotch or dark streak.

Secondary Sex Characters

All males possess a nuptial pad at the base of the first finger which is finely pigmented, and an internal vocal sac which opens into the floor of the mouth by a pair of openings at the angles of the jaws. The body size of the males vary from 41-47 mm., while the female specimens are 57-60 mm. This may indicate a sex difference in body size. But more female specimens would be needed to confirm this.

Comparison

In addition to the material of *Rhacophorus cruciger eques* in the British Museum of Natural History, private collections of the author and of Mr. V. Athukorale were examined to ascertain the difference between *eques* and *nasutus*. In all the specimens of *eques* the interorbital distance was more than half the length of the snout and the dermal flap at the end of the snout was lacking. The ratio of the length of the snout to snout-vent distance in all specimens of *R. nasutus* was 4·1 to 4·5 while in *R. c. eques* it was 5·4 to 6·0. The choanae in *eques* is rounded with the vomerine teeth usually projecting beyond the level of the posterior borders of choanae while in *nasutus* the choanae are elliptical and the vomerine teeth never project beyond the level of the posterior borders of the choanae. The pigmentation on the throat of *nasutus* which runs into a constant pattern is never present in *eques*. In *eques* if pigment is present at all it is in the form of a fine speckling on the throat or as a dark thoracic streak below the corocid humeral region. Another salient feature is the markings on the back which are remarkably constant in both species, *R. c. eques* possessing a dark hour-glass shaped marking which commences at the level of the eyes to terminate at the sacral region, in contrast to the parallel lines of *nasutus*. The tibio-tarsal articulation of the adpressed hind limb which reaches to the naris or between the nares in *nasutus* reaches to the eye or only barely between the eye and the nares in *eques*.

Habits and Habitat

All the specimens of *R. nasutus* were collected on bamboo, *Ochlandra stindula*, which is the characteristic vegetation of this zone, Leiter (1948). They favour dark forests with thick undergrowth and are found at a height of about eight to ten feet from the ground. All the male specimens collected were silent and no call has been recorded yet.

ACKNOWLEDGEMENTS

I am deeply grateful to Miss A. G. C. Grandison of the British Museum for her helpful suggestions and constructive criticism of this paper and to Mr. V. Athukorale for his assistance in the field and for the loan of his collection.

18, DON CAROLIS ROAD,
JAWATTE,
COLOMBO-5,
CEYLON,
June 29, 1967.

F. R. SENANAYAKE

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DE SILVA, P. H. D. H. (1955): A list of the Amphibia recorded from Ceylon with a report on the amphibia in the Colombo Museum. *Spolia Zeylanica* **27** : 251-253.

GUNTHER, A. (1868): First account of tailless Batrachia added to the collection of the British Museum. *Proc. Zool. Soc. London* pp. 478-490.

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KIRTISINGHE. P. (1957): The Amphibia of Ceylon Colombo, Ceylon.

LEITER, N. (1948); Geographical studies of the Nitre cave district. *Bull. Ceylon. Geog. Soc.* 3 : 138-142.

WOLF, S. (1936): Revision der Untergattung Rhacophorus. *Bull. Raffles Museum* **12** : 137-217.

16. ON A RECORD OF THE BLENNIID FISH *CRUNATUS DEALMEIDA* (SMITH) FROM INDIAN WATERS

(*With a photograph*)

Five male and three female specimens of *Crunatus dealmeida* (Smith) were noted in a collection of fish from the east coast of India made by Mr. N. V. Subba Rao of the Zoological Survey of India between November-December 1964. The species was collected at Upputeru, a backwater canal near Nizampatnam (15° 54′ N., 80° 43′ E.), 3 km. from the coast. This is the first record of *C. dealmeida* from the Indian seas; the species being known so far only from South Africa.

Sexual dimorphism is evident. The female can be distinguished by the greater length of the caudal and the pelvic fins in relation to standard length and the greater width of the body. A dark mark on the last three dorsal rays further distinguishes the males. Detailed descriptions of the male and the female are given below.

Crunatus dealmeida (Smith)

1949. *Omobranchus dealmeida* Smith, *Ann. Mag. Nat. Hist.* (12), 2, p. 104 (Type locality : from a rock-pool, Ponte Maone, Delagoa Bay).

1959. *Crunatus dealmeida* Smith, *Ichthyol. Bull. Rhodes Univ.* 14, p. 234, pl. 19, A.

1965. *Omobranchus dealmeida* Smith, *The Sea fishes of S. Africa,* 5th ed., p. 507 pl. 76, p. 344.

Male

Material: 5 ♂ ♂; 34·0-56·0 mm. in total length; 14-12-1964. Upputeru Canal, Nizampatnam. Coll. : N. V. Subba Rao.

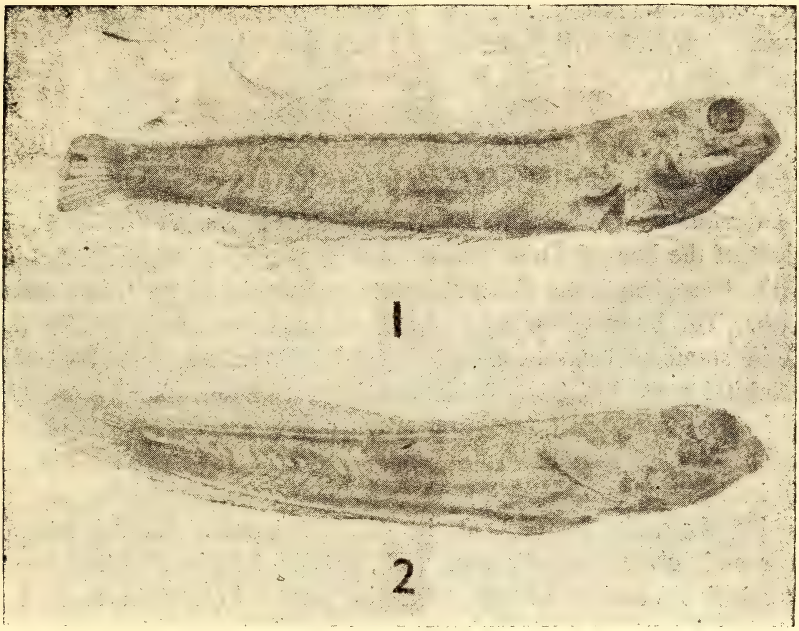

Fig. 1. *Crunatus dealmeida* (Smith) male 53 mm. in total length.
Fig. 2. *Crunatus dealmeida* (Smith) female 51 mm. in total length.

Description: D XII+22; A. II+22-23, P. 13, V. I. 2; C. 16. Height of body 7·2 (6·0-7·8) in total length, 6·1 (5·4-6·7) in standard length. Head length 4·8 (4·5-5·3) in total length, 4·1 (4·0-4·3) in standard length. Eye 1·3 (1·2-1·3) in snout, 1·9 (1·5-2·0) in post-orbital part, 3·5 (3·3-3·8) in head length. Snout sloping, 2·9 (2·5-3·0) in head length. Interorbital space concave, 4·6 (4·2-5·0) in head length. The width of the body 1·9 (1·5-2·2) in height of the body, 11·0 (8·0-13·1) in standard length. Mouth small and inferior. Lips with flaps. 18 teeth in each jaw, lower canines 2 times upper. Gill membranes broadly united with isthmus. Lower edge of gill opening opposite to the upper edge of pectoral base. Branchiostegals eight. Gill rakers 9-10 in the lower arch. Dorsal and anal free from caudal, last dorsal and anal rays joined to the caudal penduncle. Dorsal originates slightly in advance of gill opening. Dorsal spines flexible, lower than soft rays. Anal lower than dorsal. Pectoral rounded, subequal, 1·2 (1·0-1·4) to pelvics, 1·3 (1·2-1·4) in head length.

Pelvics equal to head, 4·4 (4·2-4·6) in standard length; two rays joined at the basal part, the inner ray longer reaching the vent. Caudal truncate, upper and lower rays produced, 4·4 (4·1-4·6) in standard length. Lateral line consists of 3 tubes in front.

Colour in alcohol: Fins hyaline. Body uniform reddish-brown. An oval dark patch on the last three dorsal rays.

Female

Material: 3 ♀♀; 46·0-51·0 mm. in total length; 14-12-1964, Upputeru Canal, Nizampatnam. Coll.: N. V. Subba Rao.

Description: D. XIII+21; A. II+22; P. 13; V. I. 2; C. 16. Height of the body 6·7 (6·4-7·2) in total length, 5·8 (5·5-6·2) in standard length. Head length 4·8 (4·6-4·9) in total length, 4·2 (4·0-4·4) in standard length. The body width 1·6 (1·4-1·7) in height of the body, 9·2 (8·8-9·8) in standard length. Eye 1·3 (1·2-1·3) in snout, 1·9 (1·8-2·0) in postorbital part, 3·4 (3·3-3·5) in head length. Snout sloping, 2·5 (2·5-2·6) in head length. Interorbital space concave, 4·4 (4·0-5·0) in head length. Pectoral rounded nearly equal 1·0 (1·0-1·1) to pelvics, 1·3 (1·3-1·4) in head length. Pelvics shorter than head, the inner ray not reaching the vent, 5·0 (4·9-5·2) in standard length. Caudal truncate, upper and lower rays not produced, 5·0 (4·9-5·1) in standard length. Lateral line consists of 2-3 tubes in front. Colour in alcohol as in male without an oval dark patch on the last three dorsal rays.

ACKNOWLEDGEMENTS

I am grateful to Dr. A. G. K. Menon for going through the manuscript and to Dr. M. Babu Rao of the Zoological Survey of India, for offering valuable suggestions during the preparation of this paper.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA,
April 13, 1967.

K. V. RAMA RAO

17. MULLETS ON ROD AND LINE IN CHILKA LAKE

Rod and line fishing is becoming popular in Chilka Lake in recent years. Anglers, other than professional fishermen, take to this in autumn and winter months. The angling is not sport-motivated, but a means to add to their rations in addition to getting some hard cash. A number of boats with men comfortably seated with rod and line take position in a line along the western shores of the lake between Borodi and Jattia and also dot the lake and the outer channel.

Grey mullets are notoriously wary and infinitely cautious and have a reputation of nosing one's 'rag' or other bait and yet going unhooked. But in Chilka Lake this is not true of *Liza macrolepis* known locally as *Dangla*. The angler uses a thin bamboo rod of 3·5 metres, a line (of nylon gut) of 5 metres, a float, a light sinker and round bent hook of numbers 14/15 and 18/19. His bait is green algae, chiefly of *Spirogyra*. In addition he liberally mixes this algae with mud and splashes it in an arc. Rod and line fishing for mullet is similar to that described for *Crenidens crenidens*[1]. The algal bait appears to be very attractive for *Dangla* and they are caught in large numbers. As soon as the fish is hooked, the angler deftly drags it towards the boat and keeping the fish just under water hauls it out with a hand net. During our observations in 1964 we found *Dangla* in the size range 308-482 mm. occurring in rod and line catches in September and October (Table). Sizes in the range 360-439 mm. predominate in catches. Weights range from 263-923 gm.

TABLE

SIZES OF *L. macrolepis* OCCURRING IN ROD AND LINE CATCHES

Length (mm.)	Frequency (nos.)	Average wt. (calculated) of fish under each length (gm.)
300-319	5	263
320-339	4	312
340-359	9	367
360-379	21	427
380-399	14	494
400-419	12	566
420-439	23	646
440-459	11	732
460-479	1	824
480-499	1	923

Observations made in Chilka Lake indicate that *L. macrolepis* favours algae and this item takes a predominant place in its natural diet unlike *Mugil cephalus* which prefers decaying organic matter. This perhaps explains why *L. macrolepis* is attracted to algal bait while *M. cephalus* shuns it though both of them abound in the lake in autumn/winter months when they form a good fishery.

---

[1] Natarajan, A. V. & Shah, K. L. (1963): A new element in the commercial fishery of Chilka Lake. *Sci. and Cult.* **29**: 513-514.

CENTRAL INLAND FISHERIES
RESEARCH INSTITUTE,
BARRACKPORE,
April 3, 1967.

A. V. NATARAJAN
B. K. BANERJI

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18. THE COCONUT CRAB *BIRGUS LATRO* (L.) (CRUSTACEA: PAGURIDAE) IN THE GREAT NICOBAR ISLAND

(With a photograph and four text-figures)

During the expedition to Great Nicobar Island in February-May 1966, one of us (A.D.) had the opportunity to collect, and observe the habits of the well-known Coconut or Robber Crab [*Birgus latro* (L.)], which appeared to be common at Galathea Bay in this island. A number of berried females were also obtained and attempts to hatch the eggs in the camp laboratory were partially successful. The present note is based on the observations on, and collection of, *Birgus latro* from the Great Nicobar Island.

MATERIAL

In addition to the specimens dissected in the camp laboratory, the following preserved specimens were brought back to Calcutta for confirming the identification. Measurements are given in millimetres.

1. One female with eggs from Stn. No. 6, Galathea Bay, Great Nicobar Island. Collection No. 469. Date 20-3-1966.

   Carapace (Cephalothorax) length—115 (Cephalic region 62, Thoracic region 53).

   Carapace breadth—124.

2. One female from Stn. No. 7, on way to Pygmalion Point from Galathea Bay, Great Nicobar Island. Collection No. 531. Date 22-3-1966.

   Carapace (Cephalothorax) length—138 (Cephalic region 71, Thoracic region 67).

   Carapace breadth—144.

3. One female with eggs from Stn. No. 6, Galathea Bay, Great Nicobar Island. Collection No. 628. Date 25-3-1966.

   Carapace (Cephalothorax) length—99.5 (Cephalic region 53.5, Thoracic region 46.0).

   Carapace breadth—110.

Although the Zoological Survey of India party made extensive survey of the coastal areas of the island and made numerous traverses in the interior, the coconut crabs were found only at Galathea Bay. In the opinion of the coastal Nicobarese this crab occurs at Galathea Bay only.

DISTRIBUTION

The general distribution of *B. latro* has been discussed in detail by Reyne (1939). Its distribution in New Guinea has been given by Holthuis (1959, 1963) and in Dutch East Indies by Reyne (1938). In the Indian Ocean north of the equator, it is represented only on the South Sentinel Island, Andamans (Alcock 1905) and on the Nicobar Islands (Hume 1874; Alcock 1902, 1905; Man 1932).

HABITAT

B. latro is mainly nocturnal in habit and very shy. They were never seen during the day. In Galathea Bay, they were observed under fallen trees and between roots of trees at night, clinging to the roots of Pandanus and *Barringtonia* trees, arecanut and coconut palms and also in burrows and holes among coral rocks well above high tide mark where the forest extended up to the supralittoral fringe region.

HABITS

According to coastal Nicobarese of Galathea Bay region, the crabs are crepuscular and nocturnal hiding during the day except on very cloudy and rainy days. They are said to stay in their burrows even in moonlit nights and seem to be active only in total darkness. All the specimens collected by the Z.S.I. party were obtained after 7 p.m.

Food habits. The food habits of *Birgus* were studied by (i) direct observation, (ii) examination of stomach contents of newly caught animals, (iii) examination of food remains in places where the crab lives, and (iv) feeding experiments.

(i) *Direct observation:* Direct observation on the food habits is very difficult because of the nocturnal habits and shy nature of these animals. As indicated by Reyne (1939), very few observations have been made by naturalists under these conditions. These giant crabs were seen on several occasions clinging to partially eaten Pandanus, *Barringtonia* and arecanut fruits and on two occasions actually eating the fruits. In one instance a female crab was eating dead Ocypodid crabs which occur abundantly on the island. Although there are many previous records of this giant pagurid opening coconuts and eating them, attempts on the present occasion to confirm this habit were not successful. The coastal Nicobarese do not think that these crabs eat coconuts at all. In their opinion the damage to the coconuts has been wrongly attributed to these crabs, while the actual culprits are rats.

(ii) *Examination of stomach contents:* Stomachs of newly caught animals contained *Barringtonia*, Pandanus and arecanut fruits which appear to form a major source of food for the crabs. In one instance partially digested remains of a crab were also noticed.

(iii) *Examination of food remains:* The fibres of arecanut husk, partially eaten fruits of *Barringtonia* and Pandanus stacked at the entrance of numerous holes where these crabs live appear to indicate that these crabs eat *Barringtonia* and Pandanus fruits and arecanuts. In one instance the fibres of coconut husk also was observed at the entrance of a crab hole.

(iv) *Feeding experiments:* In captivity the crabs accepted cooked rice, chapathis, bananas and also coconut kernel. As pointed out by Reyne (1939) this, however, is no certain proof that coconut is also eaten under natural conditions.

Climbing habits. The ability of coconut crabs to climb coconut palms was determined as follows:—

A specimen obtained on March 19, 1966 at 10·30 p.m. was tied to a string and left at the base of a coconut palm. It backed up the palm when the lights were put off. In climbing the crab supported its body with the fourth pair of walking legs clinging to the trunk by means of its long and sharply pointed second and third pair of walking legs. It had reached the top by 2 a.m. and by 3 a.m. had nipped off the string by which it was tied. The crab stayed on the top of the palm throughout the next day without much apparent activity. At 7 p.m. on 20th, it let itself fall down to the ground, and hurried to the sea-shore where it hid itself underneath a boulder in the supralittoral fringe region. Examination of the crown of the palm where the crab had stayed revealed that it had cut away the tender shoots and had probably eaten them. None of the coconuts were damaged.

On 22 March 1966, a coconut crab was obtained at 7.30 p.m. It was raining and had become very dark by this time. The crab was tied to a string and was left at the base of another coconut palm at 8 p.m. It stayed at the base for nearly an hour and then started climbing upwards and by 8.30 p.m. had climbed 4 metres. Seeing an obstacle (kept there previously), it moved laterally to avoid it and resumed its climb reaching the top by 11.45 p.m. and by 3 a.m. it had cut away the string by which it was tied. At 8 a.m. on 23rd it jumped down apparently without injury. As this coconut palm was at the high tide mark with its trunk bending towards the sea the crab jumped down into water in the inshore region, swam and then hid itself in the crevices of corals.

Two specimens of *Birgus* (a male and a female) were tied and left at the base of a coconut palm on 23 March at 8 p.m. Both crabs climbed the palm (photograph) and reached its top by 10 p.m. By 11 p.m. one crab had snapped the string and by midnight the other one had also freed itself. These crabs stayed on top of the palm till 1 p.m. the next day. The berried female specimen jumped from the palm into the inshore area and was caught and kept on a meshed tray over a bowl filled with sea-water. After sometime it was observed that numerous zoeae were released into the water. The male crab remained on top of the palm and was retrieved the following day.

Birgus latro climbing palm

In none of the observations made did the crabs attempt to break open coconuts and eat them and only the tender shoots of coconut palm were damaged.

Other observations:

In several experiments where specimens of *Birgus* and coconuts were together in dark chambers the crabs did not touch the coconuts. However when they were offered the kernel of coconut they readily ate them.

On March 23, 1966 a female *Birgus* caught hold of the nose of a pig which was being reared by the coastal Nicobarese. The squealing of the pig attracted our attention and the crab was caught. It is quite probable that the pig had attempted to eat the robber crab and that the crab had caught hold of its nose in self protection. It is not out of place to mention here Holthuis's remark (Holthuis 1959) based on the information of Mr. Rappard on *Birgus* of Podena and Kumamta Islands, that '*Birgus* had disappeared from that island presumably as the result of the installation of a pig farm there; the robber crabs, which had been plentiful before, had disappeared entirely after the introduction of the pigs'.

BREEDING HABITS

Eggs and hatching-stage larvae:

As pointed out earlier a berried female specimen was kept on a meshed tray over a bowl filled with sea-water. The eggs are borne in grape-like bunches (Fig. 1) between the biramous limbs of second third and fourth abdominal segments. The details of this attachment to the long hairs of the biramous limbs have been described in detail by Borradaile (1900). These eggs are ellipsoidal in shape (Fig. 2) and measure 1·5 mm. in length and 0·92 mm. in breadth in live condition.

The female releases the eggs just before hatching and zoea larvae emerge within a few minutes. The zoea larva (Figs. 3 & 4) has a total length of 4·1 mm. and resembles the pagurine zoea as described by Borradaile (1900) and Harms (1932). Further developmental stages could not be studied.

ACKNOWLEDGEMENTS

The authors are grateful to: the Director, Zoological Survey of India, for facilities to undertake this work; to Dr. K. K. Tiwari and Shri A. S. Rajagopal of the Zoological Survey of India, who were kind enough to read through the manuscript and offer helpful

suggestions; to Shri C. Karunakaran, Superintending Geologist, Geological Survey of India, leader of the Expedition, for helpful suggestions

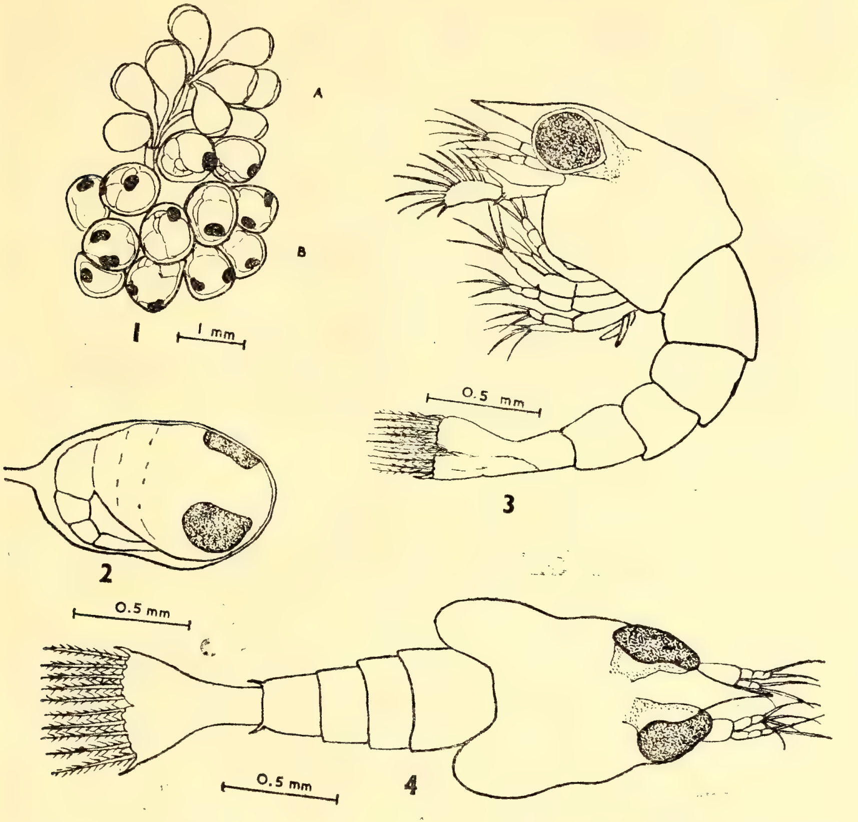

Fig. 1. Bunch of eggs of *Birgus latro* (L.) showing (A) empty cases after the larvae have emerged out and (B) eggs just before hatching ; Fig. 2. Lateral view of egg just before hatching ; Fig. 3. Zoea larva—lateral view ; Fig. 4. Zoea larva—dorsal view.

and advice in the field which are gratefully acknowledged. Thanks are also due to the various members of ZSI party for helping in the collections and observations.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA,
July 18, 1967.

A. DANIEL
V. K. PREM-KUMAR

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19. GENITALIA OF BUTTERFLIES OF THE HESPERIID GENUS *CALTORIS* AS FIGURED BY EVANS

The usual method of identifying an unknown Hesperiid is to dissect and search among the excellent genitalia plates in Evans' CATALOGUE OF THE HESPERIIDAE OF EUROPE, ASIA AND AUSTRALIA (1949). The figures for *Caltoris* present special difficulties. This is unfortunate as many species can be certainly determined only by dissection. The clasps are well drawn though the distal end of the valva of *tenuis* is broader than is shown. Yet the clasps are so alike sometimes that distinguishing is not easy. Differences in the aedeagus are clearly shown. The gnathos and uncus cause the trouble. They are fused and cannot be adequately drawn. On the dorsum is a pair of spurs (wings) of which Evans shows the left one in his side view. Only one side view, that of *confusa*, is faulty: the distal end should resemble that of *bromus* but the spur (covered with hairs) has both a short base and a conspicuous projection rather like *cahira*.

The gnathos presents two thin edges in the ventral view, which become thicker half way up and usually end in expanded tips. Tips are not expanded in *cahira* nor in *tenuis* (the two small circles in Evans are accidents of drawing) nor in *kumara kumara* (the circles in Evans' figure contradict his key and his dissections). In *kumara moorei* (not figured in Evans) the tips of the gnathos and also those of the spurs are long, erect and needle-like, resembling the ears of a hare. When the gnathos presents its edges at right angles to the body of the viewer, the thickening of the upper half can be figured, as in those of *cahira* and *tenuis*, but in others Evans shows the edges merely by a line. This is often due to the membranes lying at a slant to the viewer and so causing him to prefer a mere line. Individuals of the same species present their gnathos edges at different angles when stuck on a card after dissection. Also these edges may be near or far apart in individuals. The conclusion is that unless there are special characters such as have been mentioned above—and to these I would add the broad gnathos tips of *bromus*—the ventral figures are not of much use for identification. Shirozu in his BUTTERFLIES OF FORMOSA (1960) has large scale figures of some *Caltoris* but instead of the ventral gives the dorsal aspect which is not of much help. The tips seen at the back are in all cases the tips of the spurs; in *brunnea, aurociliata, cormasa, philippina* they are the terminal tips as the side view figures show, while in others they are the tip of the base from which the spur springs and are close to the gnathos tips.

One problem remains, that of the figures of *sirius* and *cahira*. In my naming of that part of the Tytler collection still in tins in the British Museum (Natural History)—a voluntary work—and in dissections of my own collection I was never able to find anything like them. The problem was solved when I noticed the figures of Evans in cards in the Museum cabinets. For *sirius* he first drew only the gnathos because at eye level nothing else was visible. He then drew separately two ovals with tiny points and at the base of the ovals two small circles. He got this by holding the structure far below eye level and so seeing the lower part of the dorsal spurs expanding in this way. The small circles are the tips of the top parts of the spurs lying close behind the gnathos tips. He then joined the two drawings together, evidently in order to give a complete diagrammatic figure. He did this for *cahira* also but for no other species.

The object of this paper is to save any collector of Hesperiidae from the perplexities experienced by myself in trying to match dissections exactly with the ventral figures in Evans. Except for some species of *Pelopidas* I do not remember having difficulty in other genera, so that I made a mistaken approach to *Caltoris*.

5, Upper Wimpole Street,
London, W 1, U.K.,
May 19, 1967.

KEITH CANTLIE

12

20. A NOTE ON THE OCCURRENCE OF *PROTEROMONAS CHAMELEONI* KRISHNAMURTHY, 1963 (PROTOZOA : MASTIGOPHORA)

Proteromonas chameleoni was reported by the author[1] in 1963 from the large intestine and caecum of *Chameleon zeylanicus* in Hyderabad. In the course of a survey of the flagellate fauna of amphibians and reptiles of the Hyderabad region during the years 1960-63, this parasite was found to occur only in the chameleons and was not encountered in any of the other lizards and snakes examined. However, during the present survey of the flagellate fauna of reptiles of the Marathwada region of Maharashtra State, almost identical parasites were found in the rectum of the garden lizard, *Calotes versicolor*. Four of these lizards, out of the dozen examined from Nanded District and two of the numerous lizards examined from around Aurangabad city showed the presence of this flagellate in their rectal contents.

It is interesting to record that while this species seems to be confined to the chameleons in the Hyderabad region, it is restricted to the garden lizards in the Marathwada region. Neither the five chameleons nor the numerous other species of lizards and snakes from this region showed the presence of this organism.

The organism found in the garden lizards agrees in all essential respects with the forms described originally from the chameleons. The body dimensions, however, show some slight variation, as shown in the following table:

	Strain from *Chameleon*	Strain from *Calotes*
Length of the body	10·00-15.50 μ (12·53)	10·28-20·05 μ (14·70)
Maximum breadth of the body	4·00-10.00 μ (6·73)	4·11-9.25 μ (5·83)
Length of the nucleus	1·00-3.00 μ (1·99)	1·54-2.57 μ (1·99)
Breadth of the nucleus	1·50-3.50 μ (2·40)	1·54-3.09 μ (2·20)
Length of the short flagellum	19·00-36·50 μ (27·99)	16·97-35·99 μ (28·69)
Length of the long flagellum	26·50-54·50 μ (42·33)	32·90-47·81 μ (39·10)

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[1] Krishnamurthy, R. (1963): On a new species of *Proteromonas* from the Chameleon. *J. Biol. Sci. Bombay* **6** (1): 14-18.

ACKNOWLEDGEMENTS

The work was carried out under the guidance of Dr. S. S. Qadri, Reader in Zoology, Osmania University, Hyderabad, to whom the author is indebted for his encouragement and advice. The author is grateful to Dr. S. Mehdi Ali, Professor of Zoology, Marathwada University, Aurangabad for providing the laboratory and library facilities.

DEPARTMENT OF ZOOLOGY,
MARATHWADA UNIVERSITY,
AURANGABAD,
June 24, 1967.

R. KRISHNAMURTHY

21. SOME PLANT RECORDS FOR ORISSA STATE

During studies on the ecology of Indian sea-shore plants, a few plants collected near Chandipur shore, Konarak and Puri coasts, Orissa State on identification were found to be new records for this State. A brief account on them is presented here.

Ophioglossum polyphyllum A. Br. in Webbia 9: 628, 1954.

This was collected along saline slacks in between sand dunes at Puri shore. The plant is characterised by a stoloniferous rhizome bearing caudate-acuminate, brownish-black persistent scale-like sheaths; sporangiferous portion is 1-1·5 cm. long.

Puri shore, *T. A. Rao 5930*, 3-12-1965.

Rotala verticillaris Linn. Mant. 175, 1771; Koehne in Engl. Pfreich. 17: 30, 1903.

An annual semi-erect small herb with verticillate linear leaves, found growing in the rice fields near Konarak. In India it is reported from Deccan peninsula (Clarke *l.c.*) and east coast from Nellore southwards to Tranquebar (Gamble *l.c.*).

Konarak coast, *L. K. Banerjee 5981*, 16-12-1965.

Rothia indica (Linn.) Druce in Rep. Bot. Exch. Club Brit. Isles 3: 423, 1914.

An annual herb with spreading habit. This was found on sandy bars along Chandipur shore of Orissa coast. Its distribution is mentioned in many of the local floras except Bengal and Orissa. Recently it has been reported along Digha shore in West Bengal.

Chandipur shore, *T. A. Rao 5636*, 29-11-1965.

Utricularia minutissima Vahl, Enum. 1: 204, 1804; Nair in J. Bombay nat. Hist. Soc. 62: 180, 1965.

It was found growing in association with *Utricularia stricicaulis* Stapf., *Drosera indica* L., and *Eriocaulon sieboldianum* Sieb. & Zucc. along the sandy slack ponds at Puri shore. A slender erect plant with brownish purple scape bearing pinkish flowers.

Puri coast, *T. A. Rao 5697* (*a*), 4-12-1965.

We wish to thank Dr. K. Subramanyam, Joint Director, Botanical Survey of India for going through this note critically.

ECOLOGY SECTION,
BOTANICAL SURVEY OF INDIA,
76, ACHARYA JAGADISH BOSE ROAD,
CALCUTTA-14,
November 30, 1966.

T. ANANDA RAO
L. K. BANERJEE

22. THE OCCURRENCE OF THE SMALL SNAPDRAGON *ANTIRRHINUM ORONTIUM* LINN. IN MAHARASHTRA STATE

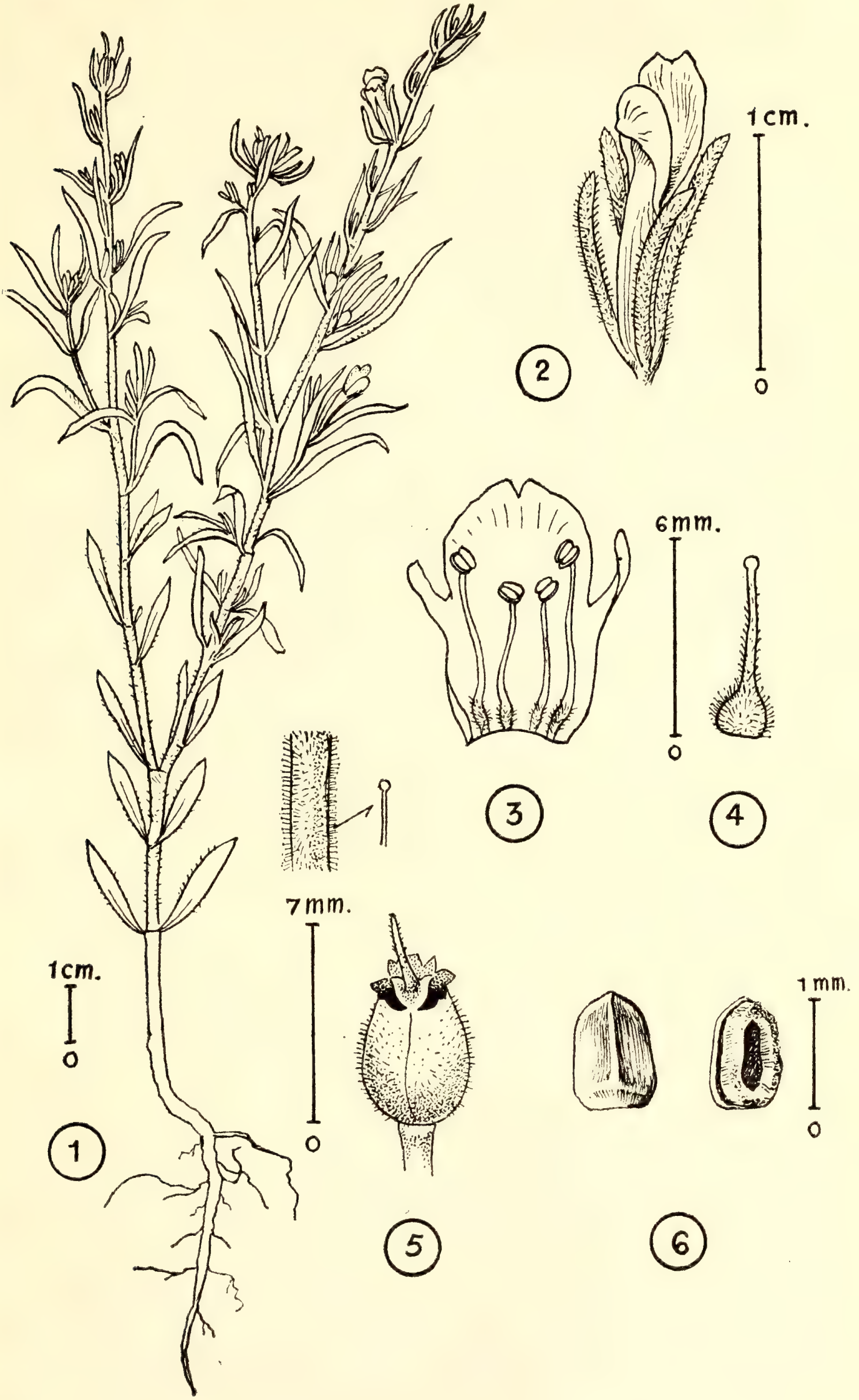
(*With a plate*)

The Small Snapdragon (*Antirrhinum orontium* Linn.) is fairly common as a weed in corn and wheat fields in temperate regions of Europe and America. It is also found frequently in Himalayan foothills, Delhi region and higher elevations of Nilgiri Hills.

This species has been recently observed growing in the experimental farm of the Wheat Rust Research Station near Mahabaleshwar. After observing agressive competition of this weed with the main wheat crop, the authorities of the Station sent a few dried samples to the author for identification. The samples were tentatively identified as above and later the author visited the area, collected a large number of fresh specimens and confirmed the identification.

Obviously seeds of this weed must have come with the wheat brought from north India for testing. This seems to be the first

Vartak: *Antirrhinum orontium*


1 cm.
0
2
6 mm.
0
3
4
7 mm.
0
1 cm.
0
1
5
1 mm.
0
6

Antirrhinum orontium Linn.

1. Entire plant; Part of stem. 2. Flower; 3. Corolla opened out; 4. Ovary, style and stigma; 5. Capsule; 6. Seed: Front view; View from the rear.

report of the occurrence of the weed in Maharashtra State; care should be taken to control its spread. Its botanical description is given below.

Antirrhinum orontium Linn. Sp. Pl. 617.

An erect annual or biennial herb, usually branched from the base, glabrous below and glandular above. *Stem* 15-45 cm. slender. *Leaves* simple, tall, exstipulate, lower opposite, upper alternate, 25-50×2-3 mm., linear, narrow, rarely oblong-lanceolate, entire. *Flowers* pale pink, streaked with purple, about 13 mm. long, solitary and nearly sessile in the axil of the upper leaves. *Calyx* 5-parted, segments linear, glandular pubescent, spreading, over-topping the corolla. *Corolla* 2-lipped, personate; tube slightly bulging at the base; upper lip erect, 2-lobed lower spreading, 2-lobed; base dilated, narrowed at throat. *Stamens* 4, didynamous, included. *Ovary* superior, glandular pubescent, bi-carpellate, syncarpous, bilocular; placentation axile with numerous ovules; style slightly lateral, stigma 2-lobed. Capsule pubescent, obliquely ovoid, about 10×5 mm., opening by 2-3 pores at the top. Seeds about 1×0·3 mm., more or less rhomboidal, compressed, and with a narrow keel on the back and a marginal rim, scooped out and lobulate inside, the lobules warted.

Flowering and fruiting—December to May.

MAHARASHTRA ASSOCIATION FOR THE
CULTIVATION OF SCIENCE,
POONA-4,
May 25, 1967.

V. D. VARTAK

23. SOME INTERESTING PLANTS FROM THE SAURASHTRA COAST

During ecological studies on the Saurashtra coast two interesting plants, *Cymbopogon gidarba* (Ham. ex Hook. f.) Haines and *Trianthema hydaspica* Edgw., were collected; of these the occurrence of *C. gidarba* is a new record for western India.

Cymbopogon gidarba (Ham. ex Hook. f.) Haines, Bot. Bihar and Orissa 1048, 1924; Bor, in J. Bombay nat. Hist. Soc. 52: 163, f. 13, 1954 and Grass. Ind. Burma, Ceyl. and Pakistan 128, 1960; *Andropogon gidarba* Ham. ex. Hook. f. in Fl. Brit. Ind. 7: 208, 1896.

Small, tufted perennial grass with hard, woody rhizomes; culms up to 25 cm. long, weak, glabrous, polished; leaves narrow, linear, acuminate, crowded at the base with membranous ligules. Panicles 3 cm. long with sessile or pedunculate branches arranged racemosely. Spikelets sessile and pedicelled; lower glume of sessile spikelet 3·8 mm. long, linear, acute with a basal coriaceous boss, above concavely grooved, 2-keeled, scabrid along keels otherwise glabrous, nerveless in between keels 2-toothed at the tip.

Bor mentions 2 varieties under this species; our plants agree with the typical variety. Bor writes: 'This species is readily separated from all other species by the boss at the base of the slotted lower glume of the hermaphrodite spikelets, and has been reported from E. Himalaya, Bihar, Orissa and Madras State'.

Dwarka sandy shore slacks, *T. A. Rao* 351, 12-10-1961.

Trianthema hydaspica Edgw. in J. Linn. Soc. 6: 203, 1862; Clarke in Fl. Brit. Ind. 2: 661, 1879; Cooke, Fl. Bombay 1: 591, 1958 (Repr. ed.); Santapau, Fl. Saurashtra 17, 1953.

Prostrate, succulent herb; branches dichotomous. Leaves fleshy, elliptic-oblong, obtuse, revolute; petioles dilated, membranous at base. Flowers axillary, solitary, sessile; calyx: tube obconic, 4-5-ribbed; lobes 5, purplish within, almost as long as tube, triangular, acuminate. Capsules conical at top, membranous, 10-12-seeded; seeds black, rugose.

This is a rare plant confined to the Sind region (now in Pakistan) and no precise locality is mentioned for this plant in Saurashtra.

Okha sandy areas, *T. A. Rao* 468, 17-10-1961.

ECOLOGY SECTION,
BOTANICAL SURVEY OF INDIA,
76, ACHARYA J. C. BOSE ROAD,
CALCUTTA-14,
July 11, 1967.

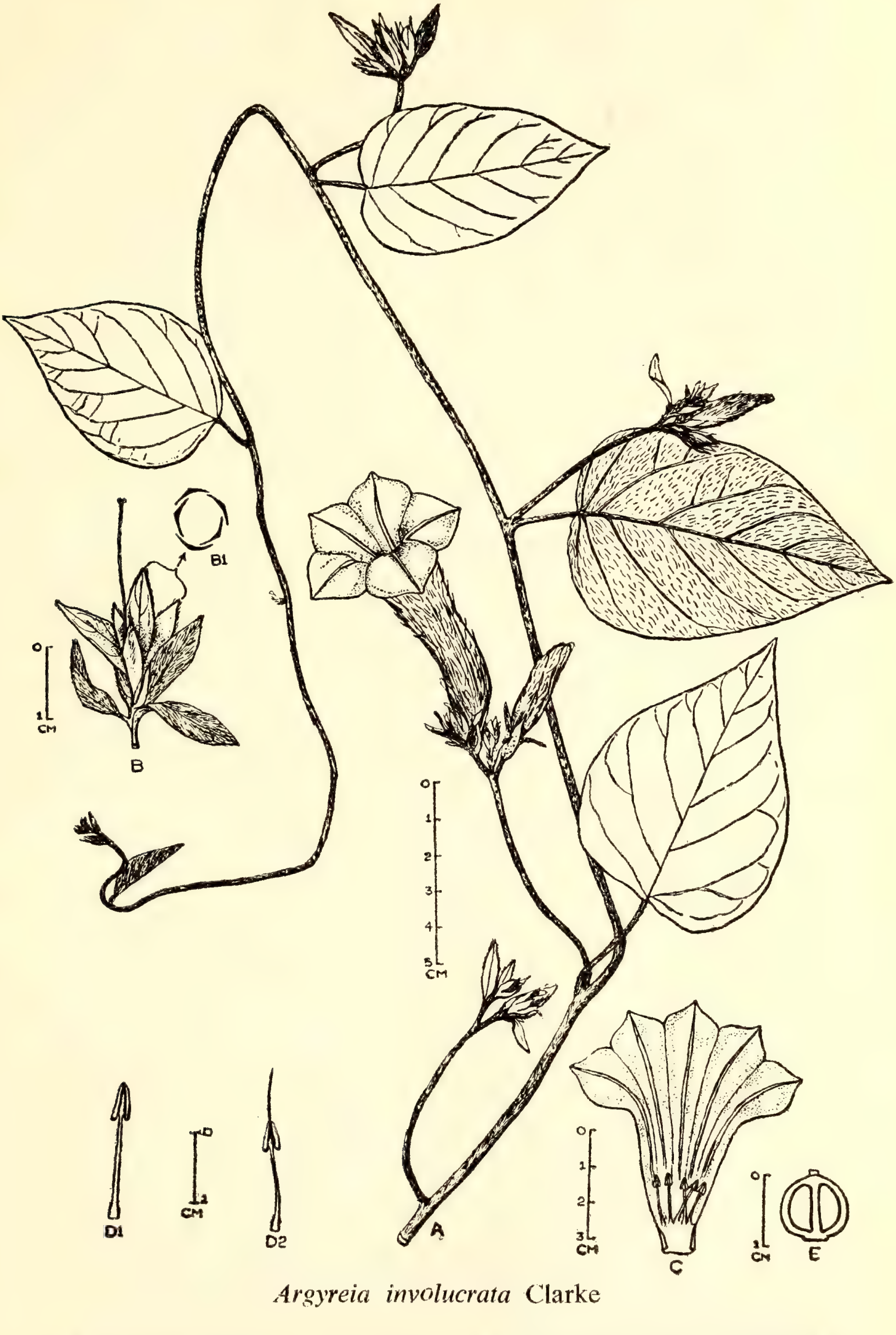
T. ANANDA RAO
B. C. KORLAHALLI

24. NOTE ON *ARGYREIA INVOLUCRATA* CLARKE (CONVOLVULACEAE)

(*With a plate*)

During our floristic studies of Champaran District, North Bihar we collected a species of *Argyreia* Lour. which on examination was identified as *Argyreia involucrata* Clarke.

Bannerjee: *Argyreia involucrata*


B1
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Argyreia involucrata Clarke

A. Flowering branch; B. Upper part of a peduncle with corolla removed to show the unequal sepals and bracts below; the style is shown arising in between the inner two sepals; B1. quincuncial sepals (diag.); C. Corolla split open; D1. Stamen (normal); D2. Stamen with a prolonged connective; E. L.S. of Fruit.

From literature and materials available to the authors in Herb. CAL., it appears that the plant has not been recorded previously from Bihar and was considered endemic to west Deccan peninsula. Its occurrence in Bihar is thus an extension of distribution for the species (Madanpur, Naurangia, Bhainsalatan, Champaran District, North Bihar, *Banerjee & Banerjee* 376, 455, & 632 in Herb. Cal.) Since the identity of this species is often confused in spite of Cooke's more or less detailed description of the species, and as no illustration exists in published literature, a plate to facilitate its identification is presented here.

BOTANICAL SURVEY OF INDIA,
CALCUTTA,
October 10, 1966.

S. P. BANERJEE
R. N. BANERJEE

25. NEW PLANT RECORDS FOR BOMBAY

Najas kurziana Rendle, Trans. Linn. Soc. II, Bot. 5: 413, t. 41, f. 116-121, 1899; Rantzien, Kew Bull. 37, 1952; de Wilde, Fl. Males. Ser. I, 6(2): 165, 1962; Prain, Bengal Pl. 847, 1963 (reprinted).

Submerged *herb*, rooting at lower nodes; stem terete, smooth, dichotomously branched; internodes 6-30 mm. long. *Leaves* 10-25×0·5-1 mm., sessile, whorled, flat, subacute or rounded at apex; margins spinous toothed; sheath 1-3×1-1·5 mm., auricled; auricles ± 1×0·5 mm., triangular. *Flowers* axillary, in fascicles of 2-4, male spathaceous, female espathaceous. *Ovary* subglobose or ovoid. *Seed* 0·8-2 mm. long, brown; areoles as long as broad.

Rare, noted on but one occasion, mixed with *Najas minor* All. in fresh water pond along railway line near Tuva Station, Panchmahal District, eastern Gujarat (*Deshpande* 1691, 1728).

Flowers and fruits: September.

Distribution: de Wilde cites India (North Bengal between Kishenganj and Oolabena, KURZ *s.m.* in CAL. & BM., once found) and Malaysia (Timor) as the localities for the distribution of this plant. To these we add Gujarat, India.

Critical notes: This species differs from *N. minor* All. as follows (adapted from de Wilde):

Flowers solitary; seeds 2·5-3 mm. long; areoles on testa much broader than long; leaves on either side with (5-) 7-15 (-17) spiny teeth ... *minor*

Flowers aggregated; seeds up to 2 mm. long; areoles on testa about isodiametrical; leaves on either side with 30-60 spiny teeth ...	*kurziana*

Wolffia microscopica (Griff.) Kurz., Journ. Linn. Soc. 9:265, 1867; Hooker f., Fl. Brit. India 6:558, 1893; Prain, Bengal Pl. 1117, 1903; Duthie, Fl. Upper Gang. Plain 2:369, 1960 (reprinted). *Grantia microscopica* Griff. Notul. 3:226, 1845.

Floating *herb*; fronds ovate or obovate, glabrous, entire, flat above, conical or subcylindrical beneath. Male and female *flowers* solitary, inserted in the groove on upper surface. *Stamen* solitary. *Ovary* sessile, globose or ovoid.

Common in temporary ponds and ditches near Vaganpur Station, Panchmahal District, eastern Gujarat, mixed with *Wolffia arrhiza* Wimm. (*Deshpande* 1727).

Flowers: September-October.

Distribution: In India so far known from Punjab, Bengal and Gujarat.

Critical notes: According to Duthie, the two species differ as follows:

Fronds subglobose beneath ...	*arrhiza*
Fronds conical or subcylindrical beneath ...	*microscopica*

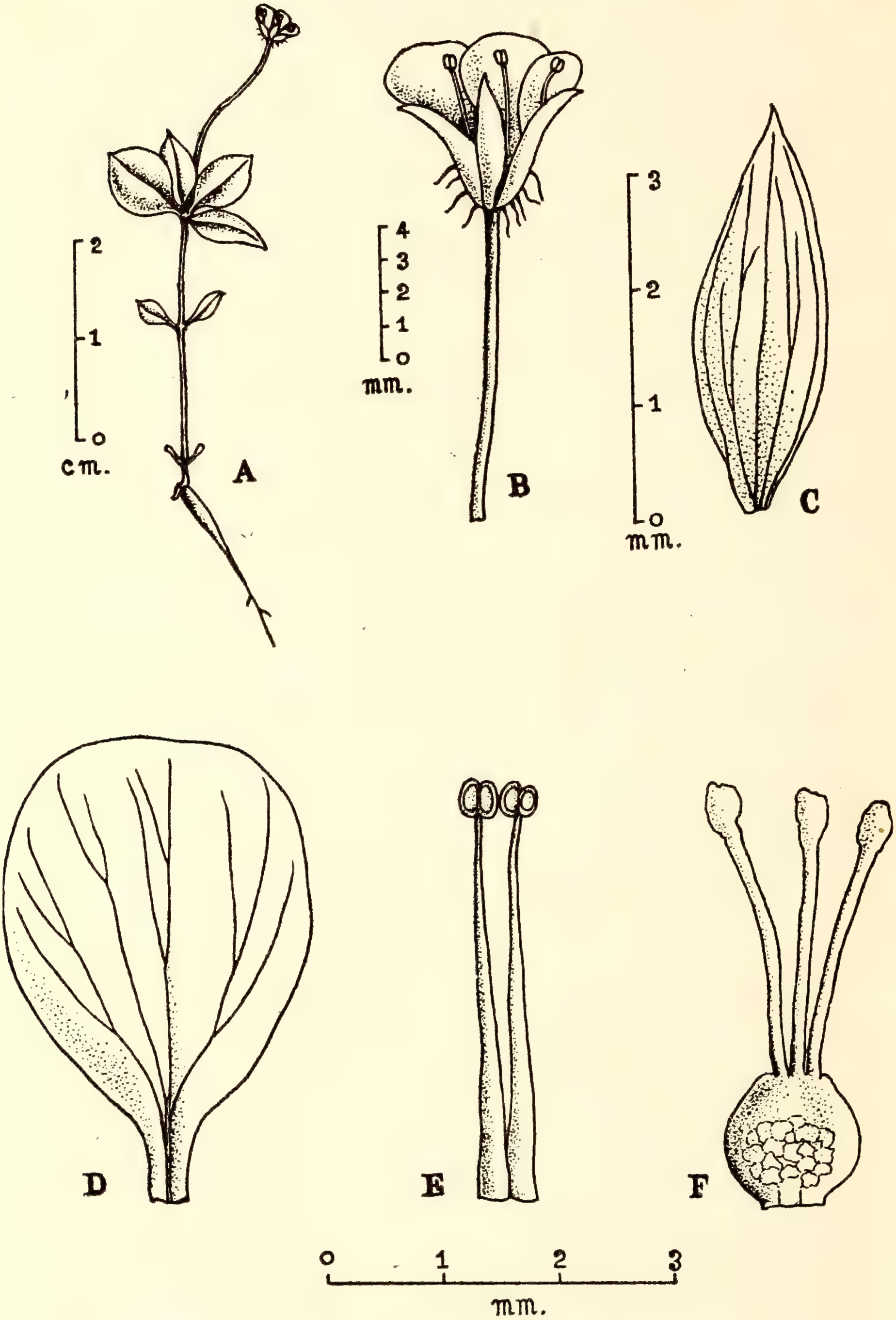
ACKNOWLEDGEMENT

The authors wish to acknowledge their deep gratitude to Dr. van Steenis, Director, Rijksherbarium, Leiden, for the identification of plants.

DEPARTMENT OF BOTANY,
SARDAR PATEL UNIVERSITY,
VALLABH VIDYANAGAR,
GUJARAT, INDIA,
March 17, 1967.

G. L. SHAH
M. B. DESHPANDE

Majumdar: *Pseudostellaria heterophylla* f. *nepalensis*



Pseudostellaria heterophylla (Miq.) Pax. f. *nepalensis* Majumdar

A. Habit of the plant showing the napiform root and the chasmogamic flower; B. A flower with part of pedicel; C. A sepal; D. A petal; E. Two stamens showing the thick-walled anthers; F. The pistil showing the ovary and three styles.

26. *PSEUDOSTELLARIA HETEROPHYLLA* (MIQ.) PAX F. *NEPALENSIS* MAJUMDAR: A NEW ADDITION TO THE HIMALAYAN FLORA

(*With a plate*)

The species *Pseudostellaria heterophylla* (Miq.) Pax. has so far been known to occur in China and Japan. It is characterised by the *upper leaves* which are apparently whorled and different in shape and size from the lower smaller pairs of opposite leaves; and the *petals* which are obovate and broad, distinguishing it from the allied species *P. palibiniana* (Takeda) Ohwi. As it was not known to the Himalayan flora, a recent record of a form of this species from the Nepal Himalayas is interesting to note. The author has identified a collection of Dr. Banerjee and Mr. P. R. Shakya from the Namche-Tyanboche locality, at an elevation of 3450 metres in E. Nepal on shady moist slopes, as of this taxon.

The genus *Pseudostellaria* Pax, formerly known as *Krascheninnikowia* Turez., was studied by Schaeftlein (1957)[1], who named a plant occurring in the western Himalayas as *Pseudostellaria cashmiriana* Schaeftlein. Another species occurring in the eastern Himalayas, China and Japan is *P. heterantha* (Maxim.) Pax. Mizushima (1966) in his studies on the Japanese species of the genus has described in detail, with a good classification five species occurring in Japan. Until recently, the studies on the Himalayan species of the genus by the author indicated that the above two species were the only representatives of the genus in the Himalayas and this taxon becomes the third of the genus in this region.

Pseudostellaria heterophylla (Miq.) f. **nepalensis** Majumdar f. nov.

Pedicelli bracteis suffulcientibus longiores. Folia inferiora superioribus minora in unum vel duplex par disposita. Petala integra, obovata. Holotypus: Banerjee et Shakya 5655 e Namche-Tyanboche in Nepal, alt. 3450 m. positus in CAL.

Pedicels longer than the subtending bracts. Lower leaves smaller, only one or two pairs. Petals entire obovate. Cleistogamous flowers not seen.

---

[1] Schaeftlein, H. (1957): Die Systematische Stellung von *Stellaria bulbosa* Wulfen. *Phyton* (Ann. Rei.-Bot.) 7: 186-198.

Holotype: Banerjee & Shakya 5655, from Namche-Tyanboche in Nepal, alt. 11500 ft. (3450 m.), preserved in the Calcutta Herbarium (CAL).

Distribution: Nepal Himalayas.

ACKNOWLEDGEMENTS

The author expresses his sincere thanks to Dr. S. K. Mukerjee, Keeper, Central National Herbarium, Howrah, for his kind help and suggestions, and to Rev. Father L. Cramer of St. Aloysius College, Ceylon, for kindly rendering the diagnosis into Latin.

CENTRAL NATIONAL HERBARIUM,
BOTANICAL GARDEN P.O.,
CALCUTTA,
March 17, 1967.

N. C. MAJUMDAR

27. ON THE OCCURRENCE OF A NEW VARIETY OF *ISOËTES COROMANDELINA* L. IN RAIPUR M. P.

(*With a text-figure*)

During the course of intensive floristic studies of Raipur and its surroundings a new variety of *Isoëtes coromandelina* L. was collected in 1964 but enough material was not available. This year again a search was made, and a large number were collected. It is a weed found in rice fields during rains.

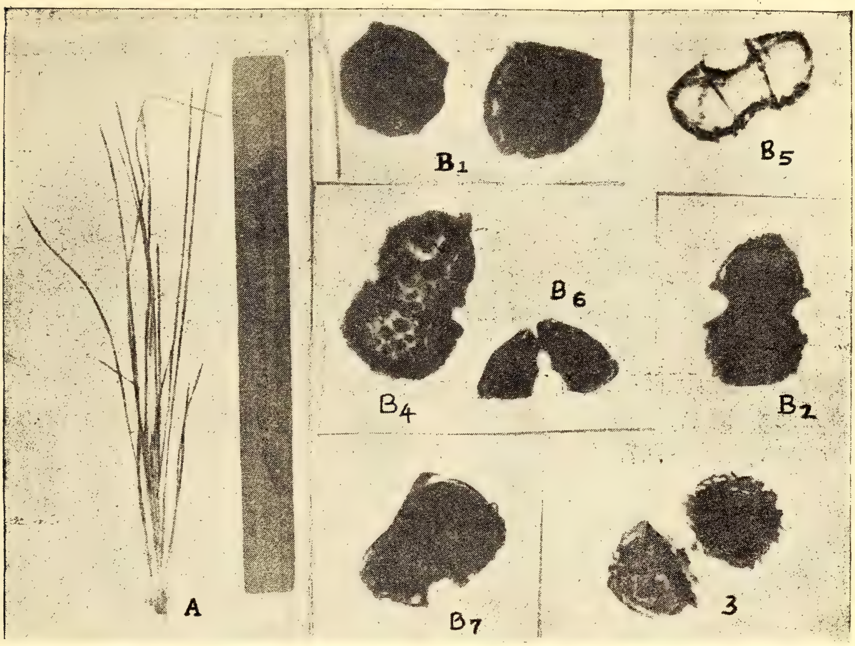
Isoëtes coromandelina L. var. **raipurensis** Unni var. nov.

Plants up to 35 cm. long (see fig. A), base expanded, stomata present only towards the upperside. Air chambers four, peripheral strands and accessory strands present. Ligule cordate. Velum absent. Megasporangia 5-7 mm. long 3-4 mm. broad, elongated. No sterile cells found. Microsporangia not found.

Number of megaspores 200-750, distinguishable into two sizes, large 384 to 512 μ and small 213 to 355 μ in diameter. Triradiate ridges of the megaspores straight and usually not branched.

Joined large and small megaspores were observed and also a few abnormally small sterile spores. In some large megaspores the outer spore wall is thin and ill-developed (see fig. B. 1 to 7). All these types of spores occur inside the same sporangium.

Locality : Dumar Tal, Raipur, Madhya Pradesh, collected in 1964 and 1966 from July to November. The isotypes have been deposited in the Royal Botanic Gardens, Kew, No. H521-66, and the holotype in the Botany Dept., College of Science, Raipur, M.P.



Isoëtes coromandelina L. var. *raipurensis* Unni

A. Complete plant; B. Megaspores enlarged; B1. Two normal megaspores; B2. Two megaspores joined together; B3. Two normal megaspores joined by tube; B4. Two megaspores joined completely by the sides; B5. Exospore incompletely developed; B6. Small immature spores joined together; B7. A small spore and a normal spore joined together.

Isoëtes coromandelina L. var. **raipurensis** Unni var. nov.

Rhizoma vulgo 3-lobum vel 4-lobum. Folia 8-20, ad 35 cm. longa, basi expansa. Stomata adsunt in partibus superioribus. Vacuola aerea 4, fasciculis peripheralibus atque accesoriis praesentibus. Ligula cordata, velum nullum. Megasporangia 5-7 mm. longa, 3-4 mm. lata, elongata. Cellulae steriles nullae visae. Microsporangia ignota. Megasporae in duas varietates distinguendae, maiores 384-512 μ et minores 213-355 μ diam. Juga triradiata recta vulgo non furcata. Megasporae 200-750 numero.

Varietas haec accedit ad *I. coromandelinam*, sed differt magnitudine minori et foliis paucioribus, megasporis minoribus et paucioribus tuberculis acutis ornatis.

Locus : Dumar Tal, Raipur, M.P., India. Ab iulio ad octobrem; typus positus in herbario College of Science, Raipur et isotypus ad Kew in Anglia, No. H521-66.

The plant is allied to *Isoëtes coromandelina* L. and *Isoëtes indica* Pant et Shrivastava, but differs in its smaller size, lesser number of spores, simple pointed tubercles of even size, absence of sterile cells and undivided triradiata ridges.

ACKNOWLEDGEMENTS

I am thankful to Prof. P. N. Mehra and Dr. G. K. Shrivastava for helping me in the identification and to Fr. H. Santapau for kindly translating the description of the new variety into Latin.

BOTANY DEPT., GOVT. COLLEGE OF SCIENCE,
RAIPUR, M.P.,
February 15, 1967.

K. SANKARAN UNNI

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1966-67

EXECUTIVE COMMITTEE

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Dr. P. V. Cherian, *Governor of Maharashtra*

Vice-Presidents

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ex officio

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Mrs. Jamal Ara	*Ranchi*
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Dr. Baini Prashad, D.SC., F.N.I.	*Dehra Dun*
Mr. P. D. Stracey, I.F.S.	*New Delhi*
Lt.-Gen. Sir H. Williams, C.B., C.B.E., M.I.C.E., M.I.E.	*New Delhi*

HONORARY SECRETARY'S REPORT FOR THE YEAR 1966

MEMBERSHIP

The total number of members on our register as on 31st December, 1966, was 1,464, including 254 life members, 2 honorary members and 75 forest department nominees and 2 student members, who receive the *Journal* at a concessional rate of Rs. 20. During the year, 91 ordinary and 8 life members joined and 43 ordinary members and 3 life members resigned or died. Among the 1,133 ordinary members, 746 have paid the subscription for the year and we have to receive subscription for 1966 from 387 members. In accordance with rule 14 of the rules and regulations, members in arrears for over two years have been sent a letter requesting them to continue their membership, and if it was not possible to inform us accordingly.

Attention is drawn to the fact that the number of ordinary members in good standing has remained static at about 750 for the last several years. This is a very unsatisfactory state of affairs. We appeal to you for help to enrol interested persons, for unless more members are enrolled it would be difficult for the Society to continue with its activities. It may be noted that corporate members pay the same amount as individuals. Business firms and other institutions interested may be approached to become members of the Society. The membership fee which remained unchanged since 1948 has been raised only by Rs. 6 from January, 1967, to meet the all round increase in costs.

THE SOCIETY'S JOURNAL

Only two numbers of the *Journal* were printed, Vol. 62(3) and Vol. 63(1). The 468 pages include 8 papers on botany, 4 on wild life conservation, 3 on reptiles, 2 each on birds, fishes, insects and crustacea and one on mammals. The delay in the publication of the *Journal* was largely due to circumstances beyond our control as the press was unable to keep to its printing schedule, owing to labour trouble. We hope to bring our publication schedules up-to-date during 1967.

GENERAL

BNHS/WHO Bird Migration Study Project. One camp was held at Bharatpur between 5th and 26th October, when 3747 birds (1694 waders, 1222 ducks, 821 sparrows and 10 other birds) were ringed. Blood samples collected during the camp were sent to Kievskae Shosse Institute of Poliomyelitis and Virus Encephalitis, Omsk, U.S.S.R.

Assistance from the WHO for this study ended with this camp but we are hopeful that in association with the Smithsonian Institution, U.S.A., we will be able to continue the work.

During the year we received reports of the recovery of 42 birds (five species of ducks and two of waders) bearing our rings. The largest number of recoveries (17) was of the Common Teal (*Anas crecca*).

Conferences. The XIV International Ornithological Congress at Oxford was attended by Dr. Sâlim Ali and Mr. Humayun Abdulali. Mr. Zafar Futehally attended the IX General Assembly and 8th Technical Conference of the IUCN at Switzerland. Mr. Futehally has been elected a member of the Executive Board of the IUCN.

Additions to the Collections. During the year 1434 additions were made to our collections :

Mammals	24
Birds	835
Reptiles and Amphibians	250
Insects & other Invertebrates ..	325

Among the insects, 300 specimens of wasps were donated by Fr. F. L. Wain of Poona. We are grateful to Fr. Wain for the donation.

Interesting additions to the collections are :

Mammals

Nicobar Tree-Shrew (*Tupaia nicobarica*)
Pouch-bearing Bat (*Taphozous saccolaimus crassus*)
Large Nicobar Leaf-nosed Bat (*Hipposideros diadema nicobarensis*)
Nicobar Bicoloured Leaf-nosed Bat (*Hipposideros ater nicobarulae*)
Nicobar Pipistrelle (*Pipistrellus javanicus camortae*)

Birds

Ward's Trogon (*Harpactes wardi*)

Reptiles

Pouch-clawed Skink (*Ristella rurkii*)
Tree Gecko (*Cnemaspis littoralis*)

Wild Life Preservation. It must be noted with regret that in spite of the meeting called by the Planning Commission in April, 1965, and in spite of the recommendation subsequently made at the Indian Board for Wild Life no steps have yet been taken by the Government either to institute a wild life department in the Ministry of Food & Agriculture in the Centre or establish wild life circles in the States.

Taking the present picture into account the Society formulated a wild life policy based on the past recommendations to the Planning Commission and the Ministry of Food & Agriculture. The Society will make every effort to have this policy implemented.

During the year the Society carried out correspondence with almost all Divisional Forest Officers in the country with a view to stimulate them to take a greater interest in wild life matters, and also to get an assessment from them of the wild life in their districts. The response has been discouraging in most cases, but some Divisional Forest Officers have sent in useful reports. The Society also proposed to the Chief Conservator of Forests, Maharashtra, that a short seminar be held at Bombay in which forest officers would be guided about the identification of wild life and in management techniques. The idea has been accepted in principle, and will be followed up.

An important event from the point of view of conservation was the survey of the Wild Life Sanctuaries in Northern India and Nepal by Mr. Juan Spillett of Johns Hopkins University, and his report is being published in the December 1966 issue of our *Journal*. The report points out the unsatisfactory position with regard to the administration of sanctuaries, preservation of habitats and prevention of poaching, and it is hoped that these will help to some extent in drawing attention to what needs to be done. During the year we continued to receive distressing reports of the destruction of wild life including the Great Indian Bustard, killing of elephants by poisoning and destruction of habitats of rare species like the Manipur Deer by construction of a dam at Logtak Lake. All these instances indicate the need for creating a strong public opinion in favour of conservation, and in this our members can play a valuable part.

The Maharashtra Forest Department arranged for the distribution among school children of 1,000 booklets on mammals in our Glimpses of Nature Series during the Wild Life Week. We hope that publicity of this kind will be continued in future years.

PUBLICATIONS

The sale of our publications continues to be satisfactory and we are now considering bringing out the 8th edition of the BOOK OF INDIAN BIRDS. It is also necessary to bring out fresh editions of SOME BEAUTIFUL INDIAN TREES and SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS, and a source of funds for publishing these books is being investigated.

DONATIONS

Sálim Ali/Loke Ornithological Research Fund. During the year we received a donation of $100 (Rs. 747.06) from Mrs. Laprelle Edens and Rs. 1,000 from Dr. Sálim Ali towards the fund. We thank them for the generous assistance and look forward to receiving donations from other members for building up the fund.

Furniture. On an appeal to members of the Society for assistance to purchase chairs for the auditorium, the following members very generously sent us donations :—

Dr. Sálim Ali (Rs. 128) ; Mr. S. Moolgaonkar (Rs. 320) ; Mr. G. S. Ranganathan (Rs. 320) ; Mr. D. W. Parrack (Rs. 64) ; Mr. G. V. R. Frend (Rs. 500) ; Mr. Sudyam Cutting (Rs. 744.27) ; Mrs. Spurway (Rs. 64) ; Mr. Jayakar (Rs. 64) ; Maharaja of Kotah (Rs. 320) ; Maharawal Sahib Bahadur of Dungapur (Rs. 64) ; Mr. J. Gupta (Rs. 70) ; Sir Evelyn Howell (Rs. 64) ; Mr. R. E. Hawkins (Rs. 128) ; Mrs. M. Divers (Rs. 47.12) ; Dr. Henry Field (Rs. 66.51) ; Mr. Hari Narayan Acharya (Rs. 125) ; Mr. M. E. Wilkinson (Rs. 10) ; Mr. F. D. Wadia (Rs. 100) ; Sir Reginald Maxwell (Rs. 419.64).

With this assistance we were able to purchase 50 chairs and we would welcome further donations to buy an additional 50 chairs.

The Government of India, through the Ministry of Education gave us a grant of Rs. 31,500 for purchasing steel cabinets for large mammals and bird specimens kept in wooden and tin boxes. We are very grateful to the Ministry of Education for the assistance.

RESEARCH STUDIES

Bhutan Bird Survey. In February/March, 1966, Dr. Sálim Ali accompanied by Assistants from the Society surveyed the bird fauna of Bhutan. A representative collection of birds totalling 511 specimens including the rare Ward's Trogon (*Harpactes wardi*) was made. The collection will be reported on in a later issue of the *Journal*. The assistance rendered by Mr. J. D. Panday is gratefully acknowledged.

Nicobar Bird Survey. From 19th February to April 19th, 1966, Mr. Humayun Abdulali accompanied by Assistants from the Society surveyed the fauna of the Nicobar group of Islands. The collection of 280 birds includes 3 new races which have been described in Vol. 63(2) of the *Journal*. The complete report on the bird collection is being published in the August, 1967 issue of the *Journal*, Vol. 64(2). The bats collected during this trip as well as bats obtained during the earlier survey of the Andaman Islands are being reported on by Mr. J. E. Hill of the British Museum in the April, 1967 issue of the *Journal*, Vol. 64(1).

Dorabji Tata Trust Field Grant Fund. With assistance from the fund, the Curator and Mr. P. Kannan surveyed the status of the Nilgiri Langur (*Presbytis johni*) and the Lion-tailed Macaque (*Macaca silenus*) in their habitats in Kerala and Madras States. The position of these animals is not satisfactory as the evergreen forests which they inhabit are being replaced with eucalyptus plantations.

Herpetological Survey. Collections were made from various localities in the Western Ghats and some very interesting material was obtained.

University Department. Mr. P. Kannan was awarded the M.Sc. degree in Field Ornithology for his work on ' Ornithophily ' or the pollination of flowers by birds. We have two other students doing research on Field Ornithology problems. The Society is now recognised for the M.Sc. and Ph.D. degrees of the Bombay University with Dr. Sálim Ali and the Curator as research guides.

Birds and Agriculture. We have submitted to the Council of Scientific and Industrial Research a comprehensive research project for the assessment of birds in relation to Agriculture. We hope we will receive the necessary financial assistance to commence work.

NATURE EDUCATION SCHEME

The scheme is now in its 19th year and its activities have been extended to the Bombay environs as well as to Poona. A competition was held during the year for the best nature study exhibits and the trophy presented by the Society was won by the J. J. Girls' High School, Bombay. In addition to the usual activities of lectures at the Natural History Section of the Prince of Wales Museum and at schools, children and teachers were taken on various field trips.

We are glad to report that the Seth Purushotamdas Thakurdas and Divaliba Charitable Trust has very generously donated a sum of

Rs. 11,000 towards the publication of booklets on Natural History in Marathi and Gujarati for free distribution among school children in selected districts in Maharashtra and Gujarat. We have started work on the booklets.

LIBRARY

During the year 147 books were added to the Library. Among these 77 were donated by the Trustees of the late Mr. Hamid Ali. Other donations were 24, and 6 books were purchased and 40 received for review. Our thanks are due to the donors and to the publishers who have sent us review copies.

EXHIBITION

An exhibition of 'Birds on Stamps' from the collections of Mr. D. R. Mistry was held at the Society's auditorium for a week in December, 1966.

TALKS

Dr. William Macnae of the University of Witwatersrand, Johannesberg, spoke to members on 'General Ecology of Southern Africa' on 30th November, and Dr. P. R. Pisharoty gave a talk on 'Tropical Meteorology' on 5th December.

REVENUE ACCOUNT

The audited statement of accounts for the year follow this report. While the Society is not immediately in difficulties it does not have the resources to reprint its books without financial aid from other sources. In view of the increase in printing costs it would also be necessary to reduce the size of the Journal.

STAFF

The Committee wishes to record its appreciation of the willing co-operation of the entire staff in the activities of the Society.

ACKNOWLEDGEMENT

The Committee's thanks are due to Mr. J. L. Bernard who continues to look after the Society's interests in the United Kingdom.

Registered No. F. 244 (BOM.)

BOMBAY NATURAL HISTORY SOCIETY

THE BOMBAY PUBLIC TRUST ACT 1950

SCHEDULE VIII [VIDE RULE 17 (1)]

BALANCE SHEET AS AT 31 DECEMBER 1966

FUNDS AND LIABILITIES		Rs. P.	Rs. P.
Trust Fund or Corpus:			
Life Membership Fund:			
Balance as per last Balance Sheet ..		79,835.28	
Add: Amount received during the year		2,600.00	82,435.28
Fixed Assets Fund:			
Balance as per last Balance Sheet ..		39,125.22	
Add: Additions during the year ..		3,618.54	
		42,743.76	
Less: Depreciation adjusted ..		5,733.27	37,010.49
Provision for Capital Losses:			
Out of the profit received on redemption of security sold during the year..			838.38
Other Earmarked Funds:			
Field Work Fund:			
Balance as per last Balance Sheet	2,764.64		
Add: Amount received during the year ..	2,500.00		
	5,264.64		
Less: Spent during the year.	2,900.00	2,364.64	
Expedition Fund:			
Balance as per last Balance Sheet	386.00		
Less: Spent during the year	342.26	43.74	
Carried forward ..		2,408.38	1,20,284.15

ASSETS	Rs. P.	Rs. P.
Immovable Properties		nil
Motor Car:		
Balance as per last Balance Sheet ..	7,930.88	
Less: Depreciation during the year..	1,586.17	6,344.71
Furniture, Fixtures & Equipment:		
Balance as per last Balance Sheet ..	33,961.76	
Less: Sold during the year ..	1,300.00	
	32,661.76	
Additions during the year ..	3,870.02	
	36,531.78	
Less: Depreciation during the year..	4,147.10	32,384.68
Investments: (At cost)		
Rs. 11,000 4% Bombay Port Trust Bonds ..	8,470.00	
Rs. 5,000 4% Bombay Improvement Trust Bonds 1908 ..	3,800.00	
Rs. 25,000 3% Conversion loan 1946-86 ..	25,000.00	
Rs. 2,000 3% 1st Development Loan 1970-75 ..	1,948.75	
Rs. 43,000 (Market value Rs. 29,660.50) ..	39,218.75	
Rs. 3,000 12 years National Defence Certificates ..	3,000.00	
Rs. 46,000	42,218.75	
£ 470 4½% Defence Bonds (2nd issue) at cost ..	6,266.67	
Carried forward ..	48,485.42	38,729.39

BALANCE SHEET AS AT 31 *DECEMBER* 1966—(*continued*)

FUNDS AND LIABILITIES		Rs. P.	Rs. P.
Brought forward ..		2,408.38	1,20,284.15
Mammal Survey Fund:			
Balance as per last Balance Sheet	25.24		
Less: Spent during the year .. .	2.75	22.49	
Building Fund:			
Balance as per last Balance Sheet ..	30,000.00		
Less: Spent during the year	2,929.24	27,070.76	
Publication Fund:			
Balance as per last Balance Sheet ..		30,725.00	
Staff Welfare Fund:			
Balance as per last Balance Sheet ..		500.00	
Sálim Ali/Loke Wan Tho Ornithological Research Fund:			
Balance as per last Balance Sheet ..	10,080.55		
Add: Amount received during the year ..	1,936.58		
Add: Interest earned during the year ..	701.04	12,718.17	
Col. Burton's Nature Conservation Fund:			
Balance as per last Balance Sheet ..	3,024.16		
Add: Interest earned during the year ..	210.32	3,234.48	
Carried forward ..		76,679.28	1,20,284.15

ASSETS	Rs. P.	Rs. P.
Brought forward ..		38,729.39
Investments: (At cost) (contd.) (Unquoted)	48,485.42	
Less: Provision for Depreciation ..	6,750.00	41,735.42
Loans: (Unsecured, considered good)		
Loan Scholarship ..	Nil	
Other Loans (to staff) ..	115.00	115.00
Advances: (Considered good) ..		
To Trustees ..	Nil	
,, Employees (for camp expenses).	580.06	
,, Others ..	7,791.55	8,371.61
Stocks: (At cost or under)		
Books and publications ..		25,747.13
Income Outstanding:		
Rent	Nil	
Interest (Accrued)	3,402.36	
Other Income:		
Supplies and Services ..	37,855.87	
Government of Maharashtra Education Activity Grant 1966-67 ..	4,000.00	
Government of Maharashtra Maintenance Grant 1966-67 ..	30,160.00	
Government of Maharashtra Building maintenance Grant 1966-67 ..	2,000.00	
Government of India		
Grant for Journal Expenses 1966-67.	10,000.00	
National Institute of Sciences		
Grant for Journal Expenses 1966-67.	1,000.00	88,418.23
Carried forward ..		2,03,116.78

BALANCE SHEET AS AT 31 *DECEMBER* 1966—(*continued*)

FUNDS AND LIABILITIES		Rs. P.	Rs. P.
Brought forward ..			1,20,284.15
Other Earmarked Funds—(contd.)		76,679.28	
Grant from California Academy of Sciences for Herpetological Survey:			
Balance as per last Balance Sheet ..	898·00		
Add: Amount advanced by the Society ..	11·69		
	909·69		
Less: Utilized during the year ..	909·69	..	
Grant from Govt. of Bhutan for the Survey of Birds to Dr. Sálim Ali:			
Balance as per last Balance Sheet ..	9,962·20		
Less: Utilized during the year ..	6,994.81	2,967.39	
Unspent Grant World Health Organization			
Balance as per last Balance Sheet ..	8,285.88		
Add: Amount advanced by the Society ..	586.24		
	8,872.12		
Less: Utilized during the year ..	8,872.12	..	
Carried forward ..		79,646.67	1,20,284.15

ASSETS	Rs. P.	Rs. P.
Brought forward ..		2,03,116.78
Cash and Bank Balances:		
(*a*) In Current Account with:		
National & Grindlays Bank Ltd., Bombay. ..	14,893.12	
National & Grindlays Bank Ltd., London (£113-18-3) ..	2,385.60	
Chartered Bank, Bombay ..	316.47	
In fixed Deposit with:		
National & Grindlays Bank Ltd., Bombay	86,000.00	
Bank of India Ltd., Bombay ..	39,000.00	
(The above Accounts are in the name of the Bombay Natural History Society)		
(*b*) With the Trustees	nil	
(*c*) With the Cashier	730.74	1,43,325.93
Income and Expenditure Account		
Balance as per last Balance Sheet ..	25,557.40	
Add: Deficit as per Income and Expenditure Account	323.65	25,881.05
Carried forward ..	..	3,72,323.76

BALANCE SHEET AS AT 31 *DECEMBER* 1966—(*continued*)

FUNDS AND LIABILITIES		Rs. P.	Rs. P.	ASSETS	Rs. P.	Rs. P.
Brought forward ..			1,20,284.15	Brought forward ..		3,72,323.76
Other Earmarked Funds—(contd.)		79,646.67				
Grant from Smithsonian Institution : For the secretarial assistance to Dr. Sàlim Ali on the publication of Handbook of Indian Birds in five volumes..	24,973.65					
Less : Spent during the year ..	1,684.00	23,289.65				
Grant from Seth Purushotamdas Thakurdas and Divaliba Charitable Trust : For the publication of Nature study booklets for free distribution ..		11,000.00				
Grant Government of India (*Unspent*) (for the publication of Handbook of Indian Birds in five volumes) Balance as per last Balance Sheet	25,000.00					
Less : Utilized during the year ..	11,276.68	13,723.32				
Carried forward ..		1,27,659.64	1,20,284.15	Carried forward ..		3,72,323.76

BALANCE SHEET AS AT 31 *DECEMBER* 1966—(*continued*)

FUNDS AND LIABILITIES		Rs. P.	Rs. P.	ASSETS	Rs. P.	Rs. P.
Brought forward ..			1,20,284.15	Brought forward ..		3,72,323.76
Other Earmarked Funds—(contd.)		1,27,659.64				
Grant Government of India (*Unspent*)						
For the purchase of steel cabinets 1965-66 ..						
Balance as per last Balance Sheet ..		31,500.00				
For the survey of birds at Nicobar Islands 1965-66.						
Balance as per last Balance Sheet ..	9,000.00					
Less: 50% of the total expenditure on survey camp adjusted ..	2,842.26	6,157.74				
Grant Government of Maharashtra (*Unspent*)						
1964-65 Unspent Balance brought forward ..	4,275.67					
Less: Refunded to Government ..	4,275.67	..				
1965-66 Unspent Balance brought forward ..	7,786.36					
Add: Amount advanced by the Society ..	435.40					
	8,221.76					
Less: Spent during the year (as per Income & Expenditure Account) ..	8,221.76	..				
Carried forward ..		1,65,317.38	1,20,284.15	Carried forward ..		3,72,323.76

BALANCE SHEET AS AT 31 *DECEMBER* 1966—*(continued)*

FUNDS AND LIABILITIES		Rs. P.	Rs. P.	ASSETS	Rs. P.	Rs. P.
Brought forward ..			1,20,284.15	Brought forward ..		3,72,323.76
Other Earmarked Funds—(contd.)		1,65,317.38				
1966-67 *Grant for the year.*						
For Establishment Expenses ..	30,160.00					
Less: Spent during the year as per Income and Expenditure Account ..	20,337.18					
	9,822.82					
Less: Refund of amount advanced by the Society for the year 1965-66 ..	435.40					
		9,387.42				
For Building Maintenance 1966-67.						
Amount received during the year ..	2,000.00					
Less: Spent during the year as per Income and Expenditure Account ..	1,136.87	863.13	1,75,567.93			
Liabilities						
For Expenses ..	..	64,809.62				
,, Advance Subscriptions	..	949.16				
,, Sundry Credit Balances	.	10,712.90	76,471.68			
Total ..			3,72,323.76	Total ..		3,72,323.76

The above Balance Sheet to the best of my belief contains a true account of the Funds and Liabilities and of the Property and/Assets of the Trust.

As per our report of even date
(Sd.) A. F. Ferguson & Co.,
Chartered Accountants

(Sd.) J. D. Kapadia,
Trustee

Bombay, 15*th June*, 1967

Registered No. F. 244 (BOM.)

THE BOMBAY NATURAL HISTORY SOCIETY BOMBAY-1

THE BOMBAY PUBLIC TRUST ACT 1950

SCHEDULE IX [VIDE RULE 17(1)]

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 *DECEMBER* 1966

EXPENDITURE	Rs. P.	Rs. P.	INCOME	Rs. P.	Rs. P.
To Expenses in respect of properties :			*By Rent :*		
			Accrued	nil	
Rates, Taxes, & Cesses ..		nil	Realized	nil	
Repairs, and Maintenance ..		nil			nil
Salaries		nil	,, *Interest* (Accrued and Realized)		
Insurance		nil	On Securities	2,842.10	
Depreciation (by way of provision or adjustments)		nil	,, Bank Account	3,747.44	6,589.54
			,, *Dividends :*		nil
,, *Expenditure from Grants from Government of Maharashtra :*			,, *Donations :*		
			In cash	nil	
			In kind	nil	
For 1965-66 : Salaries	8,221.76				ni
For 1966-67 : Salaries	20,337.18		,, *Grants :*		
Building Maintenance	1,136.87		,, *Government of Maharashtra :*		
		29,695.81	For 1965-66 (Expended as per contra)	8,221.76	
			For 1966-67 (Expended as per contra)	20,337.18	
			For 1966-67 (Expended as per contra)	1,136.87	
			For Educational Activity Grant 1966-67	4,000.00	
Carried forward ..		29,695.81	Carried forward	33,695.81	6,589.54

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1966—(continued)

EXPENDITURE	Rs. P.	Rs. P.
Brought forward ..		29,695.81
To Establishment Expenses :		
Salaries including Dearness Allowance	37,666.38	
Society's contribution to Staff Provident Fund	3,071.95	
Postages	1,541.65	
Printing and Stationery	1,729.28	
Advertisements	97.35	
Telephone charges	343.59	
Bank charges	224.83	
Meeting Expenses	669.59	
Motor Car Charges	793.80	
Conveyance and Travelling ..	119.19	
Rent	2.00	46,259.61
To Miscellaneous Expenses :		
General Charges	1,102.37	
Fire and Equipment Insurance ..	261.27	
Repairs to Furniture	42.00	1,405.64
,, Remuneration to Trustees ..	nil	
Remuneration (In the case of Math)	nil	
Legal Expenses	9.00	
Audit Fees	750.00	
Contribution and Fees	nil	759.00
,, *Amounts Written off :*		
(*a*) Bad Debts	nil	
(*b*) Loan Scholarships	nil	
(*c*) Irrecoverable Rent	nil	
(*d*) Other Items	nil	nil
Carried forward ..		78,120.06

INCOME	Rs. P.	Rs. P.
Brought forward ..		6,589.54
Grants: (contd.)	33,695.81	
Government of India :		
For Journal Expenses for 1966-67	10,000.00	
National Institute of Sciences :		
For Journal Expenses 1966-67 ..	1,000.00	44,695.81
,, *Income from Other Sources :*		
Membership Subscriptions ..	22,419.03	
Entrance Fees	470.00	22,889.03
,, *Publications :*		
Journal Sales	4,952.36	
,, *Profit on sale of Books :*		
Book of Indian Birds ..	11,956.80	
Some Beautiful Indian Climbers and Shrubs	208.34	
Some Beautiful Indian Trees ..	645.12	
Butterflies of the Indian Region ..	1,433.62	
Synopsis of the Birds of India and Pakistan	901.52	
Book of Indian Animals ..	7,732.17	
Indian Molluscs	314.42	
Identification of Poisonous snake charts	298.00	
Other Publications	108.10	
Nature Calendars	1,299.76	
Carried forward ..	29,850.21	74,174.38

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1966—(continued)

EXPENDITURE	Rs. P.	Rs. P.	INCOME	Rs. P.	Rs. P.
Brought forward ..		78,120.06	Brought forward ..		74,174.38
To Depreciation :			*Profit on sale of Books* (contd.)	29,850.21	
On Investment	nil		*Less :* Packing and forwarding charges	281.99	
On Furniture	nil	nil			29,568.22
,, *Expenditure on Objects of the Trust :*			,, *Miscellaneous receipts* .. .. (including royalty Rs. 1,125.00 on Hindi edition of Book of Indian Birds) ..		3,900.62
(*a*) Religious	nil		,, Profit due to devaluation ..		2,671.34
(*b*) Educational—Journal Expenses	29,963.16		,, Deficit carried over to Balance Sheet.		323.65
,, *Library Account :*					
Subscription to other Societies .. 1,353.28					
Purchase of Books .. 363.37					
Periodical and Binding charges 146.56	1,863.21				
,, *Maintenance of Reference Collections* ..	691.78	32,518.15			
Total ..		1,10,638.21	Total ..		1,10,638.21

As per our report of even date

(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants

(Sd.) J. D. KAPADIA,
Trustee

BOMBAY, 15*th June*, 1967

BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

Receipts and Payments Account for the year ended 31 *December* 1966

RECEIPTS	Rs. P.	Rs. P.	PAYMENTS	Rs. P.	Rs. P.
To Balance as at 1st January 1966 Brought forward :			By Balance brought forward being advance from Bombay Natural History Society		1,907.25
Cash with Cashier	50.00		,, Salary of Nature Education Organiser		5,640.00
Balance with National & Grindlays Bank Ltd., Bombay on Current Account	509.63		,, Printing and Stationery ..		676.17
		559.63	,, Postages		215.80
,, Grant—Government of Maharashtra 1965-66		7,640.00	,, General Charges ..		1,198.51
,, Sales of Nature Study Booklets ..		2,208.19	,, Balance as at 31st December 1966 :		
			Cash with the Cashier ..	49.55	
			On Current Account with National & Grindlays Bank Ltd., Bombay	689.94	739.49
			,, Balance from Bombay Natural History Society carried forward ..		30.60
Total ..		10,407.82	Total ..		10,407.82

BOMBAY, 15*th* *June*, 1967

(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants

(Sd.) J. D. KAPADIA,
Trustee.

BOMBAY NATURAL HISTORY SOCIETY

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH GRANT-IN-AID

Receipts and Payments Account for the year ended 31 *December* 1966

RECEIPTS		PAYMENTS		
	Rs. P.		Rs. P.	Rs. P.
		Refund of advance from Bombay Natural History Society		500.00
Balance as at 1st January 1966 brought forward:		*Grant No. I* :		
With National and Grindlays Bank Ltd., Bombay on Savings Account	534.50	Salaries	858.92	
Grant No. I for the second half year 1965-66	4,140.62	Miscellaneous	511.53	1,370.45
Grant No. II for the year 1966-67	6,793.46	*Grant No. II* :		
Interest on Bank Account	91.00	Salaries	5,200.00	
		Miscellaneous	1,071.48	6,271.48
		Balance as at 31st December, 1966 :		
		On Savings Bank Account with National and Grindlays Bank Ltd., Bombay		3,417.65
Total	11,559.58	Total		11,559.58

BOMBAY, 15*th June*, 1967

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants

(Sd.) J. D. KAPADIA,
Trustee

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD AT HORNBILL HOUSE, APOLLO STREET, BOMBAY 1, ON FRIDAY, 11TH AUGUST 1967, AT 6.30 P.M., WITH DR. SÁLIM ALI, D.SC., F.N.I., IN THE CHAIR

(1) The Honorary Secretary's report for the year ending 31st December 1966 having been previously circulated to members was taken as read and was adopted.

(2) The Balance Sheet and Statement of Accounts presented by the Honorary Treasurer were approved.

(3) The following were elected as members of the Executive and Advisory Committees for the year 1967-68.

EXECUTIVE COMMITTEE

ex officio

President

Dr. P. V. Cherian, *Governor of Maharashtra*

Vice-Presidents

Major-General Sir Sahib Singh Sokhey, I.M.S. (Retd.)
Dr. Sálim Ali, D.SC., F.N.I.
Rev. Fr. H. Santapau, S.J.

Hon. Secretary

Mr. Zafar Futehally

Hon. Treasurer

Mr. J. D. Kapadia, I.C.S. (Retd.)

Member

Secretary, Ministry of Education, Govt. of India

Elected Members

Mr. Humayun Abdulali
Mr. G. V. Bedekar, I.C.S. (Retd.)
Prof. P. V. Bole
Mr. R. E. Hawkins
Dr. C. V. Kulkarni
Mr. Duleep Matthai
Dr. A. N. D. Nanavati, M.D.
Mr. D. J. Panday
Dr. T. Ramachandra Rao, D.SC., F.N.I.
Mr. D. E. Reuben, I.C.S. (Retd.)

ADVISORY COMMITTEE

Mr. H. G. Acharya	*Ahmedabad*
Mrs. Jamal Ara	*Ranchi*
Mr. F. C. Badhwar, O.B.E.	*New Delhi*
Sir Chintaman Deshmukh, Kt., C.I.E., I.C.S. (Retd.)	*New Delhi*
Mr. E. P. Gee, M.A., C.M.Z.S.	*Shillong*
Mr. M. Krishnan	*Madras*
Dr. N. K. Panikkar, M.A., D.SC., F.N.I.	*New Delhi*
Dr. Baini Prashad, D.SC., F.N.I.	*Dehra Dun*
Mr. P. D. Stracey, I.F.S.	*New Delhi*
Lt.-Gen. Sir H. Williams, C.B., C.B.E., M.I.C.E., M.I.E.	*New Delhi*

(4) Films received from the Canadian High Commission at New Delhi and United States Information Service, Bombay, were shown.

(5) The meeting terminated with a vote of thanks to the Canadian High Commission, the United States Information Service for the films and to the Chairman of the meeting.

PRINTED AND PUBLISHED BY C. E KOSHY AT THE DIOCESAN PRESS
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THE SOCIETY'S PUBLICATIONS

Mammals

The Book of Indian Animals, by S. H. Prater. 2nd (revised) edition. 28 plates in colour by Paul Barruel and many other illustrations. **Rs. 30**
(*Price to members Rs.* 25)

Birds

The Book of Indian Birds, by Sálim Ali. 7th (revised) edition. 64 coloured and many monochrome plates. **Rs. 25**
(*Price to members Rs.* 20)

Snakes

Identification of Poisonous Snakes. Wall chart in English, Gujarati, and Marathi. **Rs. 10**
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Miscellaneous

Butterflies of the Indian Region, by M. A. Wynter-Blyth. With 27 coloured and 45 monochrome plates. **Rs. 28**
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The Honorary Secretary,
Bombay Natural History Society,
Hornbill House, opp. Lion Gate, Apollo Street, Fort, Bombay 1-BR.

Agents in England :
Messrs Wheldon & Wesley Ltd,
Lytton Lodge, Codicote, Near Hitchin,
Herts, England.

The Society will gratefully accept back numbers of the *Journal*, particularly numbers prior to Vol. 45, from members who may not wish to preserve them.

TERMS OF MEMBERSHIP

Life Members pay an entrance fee of Rs. 5 (5*sh.*) and a life membership fee of Rs. 600. (Inland), £ 45-10-0 (Foreign).

Ordinary Members pay an entrance fee of Rs. 5 (5*sh.*) and an annual subscription of Rs. 36. (Inland), £3 (Foreign).

Members residing outside India should pay their subscription by means of orders on their Bankers to pay the amount of the subscription to the Society in Bombay on the 1st January in each year. If this cannot be done, then the sum of £3-0-0 should be paid annually to the Society's London Bankers—The National & Grindlays Bank Ltd, 26 Bishopsgate Street, London E.C. 2.

The subscription of members elected in October, November, and December covers the period from the date of their election to the end of the following year.

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